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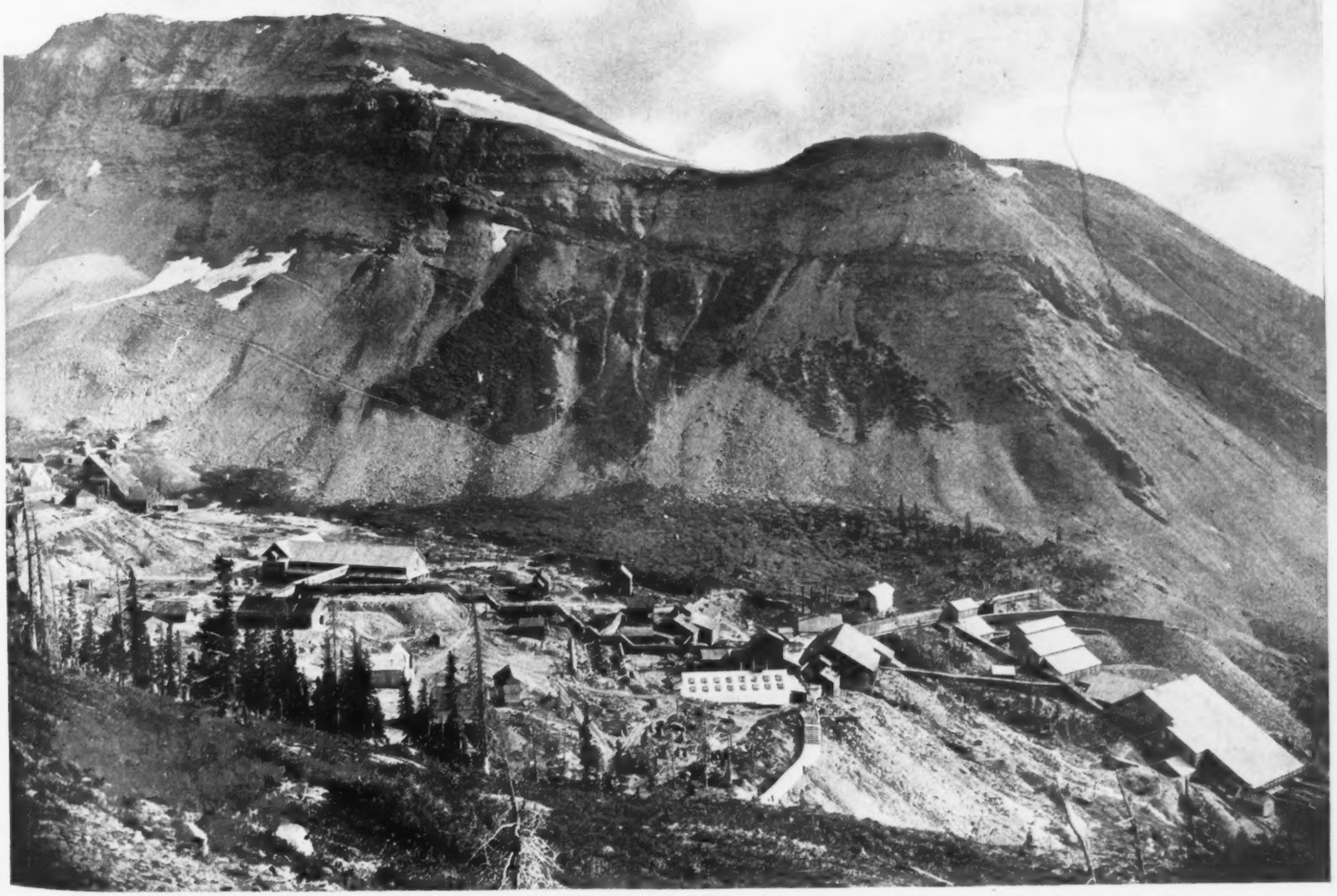
Gulf Coast Sulphur Deposits
By Cornelius Kelleher

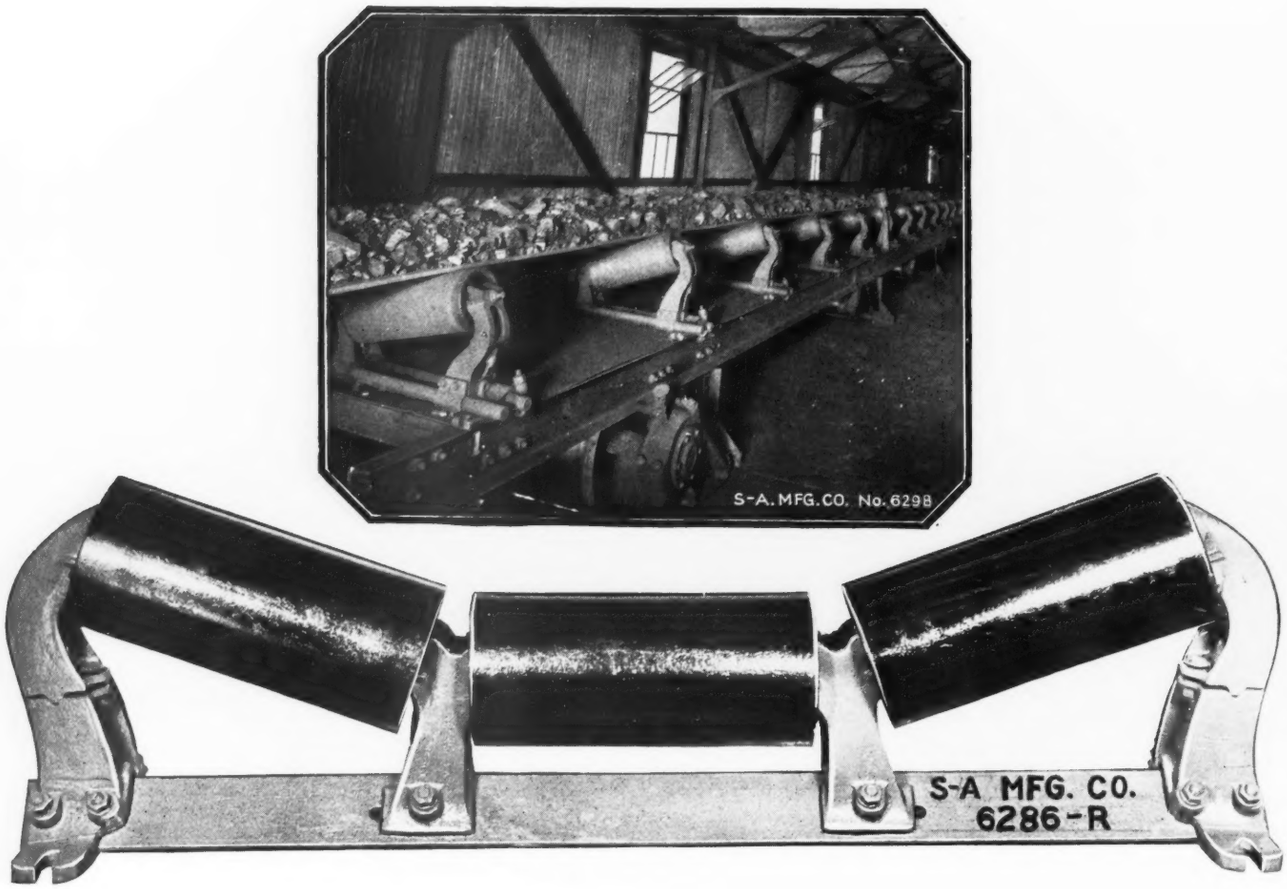
Mining Camps of North America
Globe-Miami: Leading Copper Producer in Arizona
By Cecil M. Cooper

Sixty-six Years Ago on the Gogebic Range
By Dwight E. Woodbridge

Leaching Zinc-Lead Ores with Gas House Liquor
By A. H. Hubbell



Surface Plant and Concentrator of Tomboy Gold Mines Company, near Telluride, Colorado



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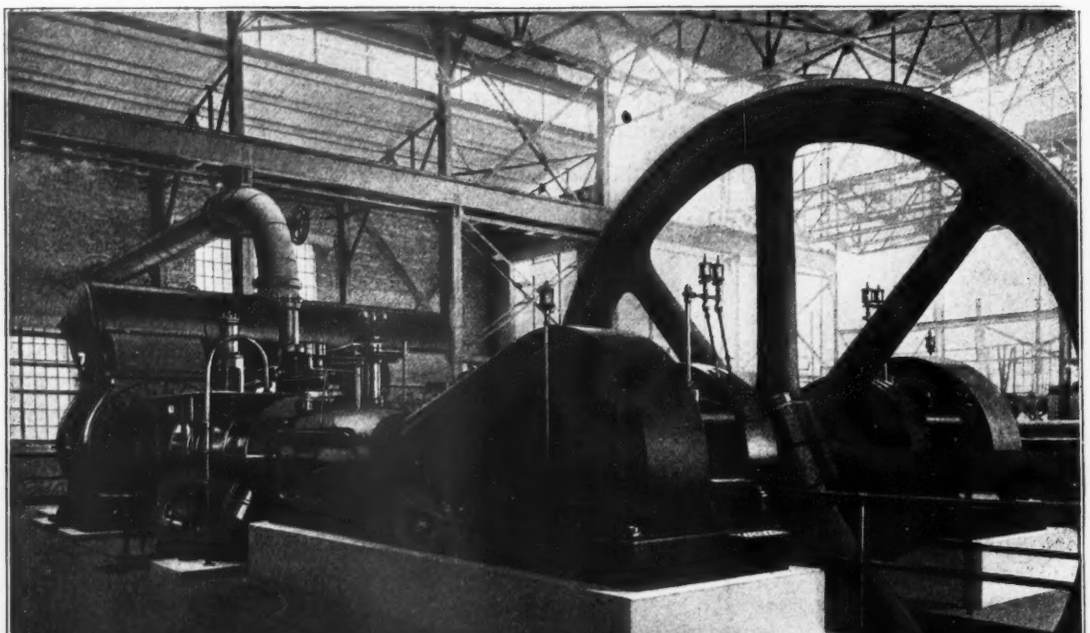

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ENGINEERING AND
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JOSIAH EDWARD SPURR, Editor

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Mobile Future Sources of Heat and Power

WITH THE POSSIBILITIES of the petroleum supply of the United States falling off within a few years, while the uses for petroleum and gasoline are increasing at an astonishing rate, the supplies of oil and gasoline from other sources than crude petroleum assume great interest. It has long been known and pointed out that the oil shales of North America—and the rest of the world—are immense in quantity and are capable of yielding liquid fuels, the only element determining and limiting the production being the cost. When the cost of producing petroleum mounts to a certain figure, with the diminution in the supply from naturally flowing wells, then it will become profitable to produce oil from shale, and an industry, the beginnings of which have already been made, will be permanent and of vastly increasing magnitude.

Another enormous source of liquid fuel has been known to be the bituminous coals, which have long yielded gaseous fuel. It has been known that distillation processes—which are the processes producing oil from shale—applied to bituminous coal could produce liquid hydrocarbons as well as the gaseous products.

Now comes a German inventor, Dr. Berghuis, who reports that bituminous or lignitic coal may be transformed into liquid oil in quite another manner—not by distillation, with a carbon residue, but by combining the coal with hydrogen under great pressure, which transforms the denser hydrocarbons of the coal into the fuel oils. From a ton of soft coal, it is stated that 140 gallons of oil may be produced, from which 45 gallons of gasoline may be separated, the remainder being fuel oil, gas oil, and lubricating oil. The oil companies are said to be competing for national rights to this process, which is stated to be economically feasible.

Altogether, it would appear that the prediction of President Thomas S. Baker of the Carnegie Institute of Technology at the International Bituminous Conference at Pittsburgh (at which Dr. Berghuis described his process) was a reasonable one:

"In less than a generation the present methods of shipping coal to be burned in its raw state under boilers hundreds of miles from the mines will appear to have been primitive and crudely unscientific."

The present trend of development, indeed, indicates that the haulage of coal—except anthracite, which cannot be liquefied—will tend to diminish, and the piping of fuels will tend to increase. The United States, which is threatened soon with loss of supremacy in liquid fuel production through the waning of its petroleum supplies, may retain that supremacy through its oil-shale supplies and above all from the liquefaction of its bituminous coal—for the United States, as is estimated by the Geological Survey, possesses 52 per cent of the coal supply of the world.

With the assurance of the definite permanency of the supply of liquid fuels, and the installation of systems of pipe lines—not only trunk lines but lines radiating to the ultimate consumer as is now being done in the case of gas—the hauling and firing of coal and the handling of ashes should tend to disappear. What hardships the anthracite industry might suffer from this change—already under way in the cities—may perhaps be adjusted by burning the coal at the mines for the production of electric power, which will be distributed to the centers of industry and population.

Kennecott Increases Dividend Rate

KENNECOTT, the world's leading copper-mining corporation, has just increased its annual dividend rate from $4 to $5 on 4,474,424 outstanding shares. Although anticipated for many months, the action is significant because it shows the Kennecott officials are convinced that nothing short of an utter collapse of the copper market can prevent a continuation of the new rate. Indeed, still further increases may follow if copper continues around 14c. per pound.

Besides the Alaskan properties that bear the name of the company, the Kennecott group includes: Braden, in South America, 99.7 per cent of which is owned by Kennecott; Utah, controlled by the ownership of more than 95 per cent of the stock; Mother Lode, its neighbor in Alaska, of which 40 per cent is owned by Kennecott; and Nevada, Ray, and Chino. Utah owns 1,000,500 of 3,427,867 outstanding shares of Nevada Consolidated, which now embraces Utah's trinity of small sisters, and this holding is quite adequate to dominate the control of the group. The current production of the seven mines is about 700,000,000 lb. of copper per year; or pro-rating this according to its shareholdings, Kennecott's output is about 525,000,000 lb. Operating costs, including depreciation and taxes, are probably under 9c. per pound of copper produced. Accordingly, on a 14c. market, Kennecott's earnings are exceeding by a good margin the $5 dividend requirements. Moreover, the properties as a group probably could increase output by 20 per cent without new capital expenditure of consequence.

Wall Street always has viewed the administration of Kennecott affairs as being ultra conservative. A year ago the company had outstanding about $10,000,000 in notes; likewise it was engaged in buying Utah shares to complete, as far as possible, its ownership of that company. Apparently one reason for deferring the dividend increase was to await the accomplishment of these plans. Today the notes are retired; and except for a small issue of Nevada Consolidated bonds, none of the companies is in debt, and earnings are directly applicable to dividends.

The conclusion should not be drawn hastily, however, that because Kennecott can thrive on the present copper market, or even a lower one, all the important copper producers can do the same. Kennecott enjoys several

advantages. The freedom from debt is important, likewise the low costs, particularly at Braden and Utah. During the third quarter of the current year the cost at Utah was 7.8c. per pound, including depreciation, taxes, and all fixed charges. Production costs of the Nevada Consolidated group are not so low, but they are lower than those of many other producers. Incidentally, silver is not an important factor in any of the Kennecott ores, as it is in many others; nor does Kennecott produce appreciable quantities of lead or zinc. As the copper market goes, so goes Kennecott's income; but its position, nevertheless, is one to be envied.

Cooling Mine Air

WHAT PROGRESS has been made in cooling mine air? In the last few years there has been talk at times of an extension of this practice. So far few companies have seen fit to follow in St. John del Rey's footsteps. There is no question as to the value of cool, dry air underground in those working places that otherwise would be warm and moist. The ability to stand the expense is the only point to be considered. Cooling, as well as heating, costs money. Perhaps the manufacturers of the equipment called for can show those companies whose conditions put them on the prospect list that the cost is not prohibitive. Here again, as he has done in so many other instances, can the manufacturer demonstrate his important relationship to the mine operator—that he is not merely living by and on the operator, but is also working on his problems with the idea of greater service in mind; in short, that he is an integral part of the mining industry.

From Granite Magma to Ore Magma

THE PROGRESSION of magmatic stages, from a rock magma through a pegmatite magma to an ore magma, and finally a magma residual from an ore magma, was succinctly described in the case of a molybdenite deposit in Nova Scotia by Dr. Charles W. Cook in a publication of the Society of Economic Geologists for last year.

First of the stages was granite—coarse-grained to porphyritic muscovite granite. Then came the intrusion of aplite dikes into the granite: next the intrusion of quartz-orthoclase (alaskite) pegmatite. The pegmatite includes sharply angular fragments of the aplite. Along contraction cracks in the pegmatite, along cleavage planes and similar planes of weakness, the penetrant ore magma, clearly the highly fluid portion of the pegmatite injection, now appeared, producing sericitization of the wall rock and the crystallization of pegmatite. The formation of sericite preceded and accompanied that of the molybdenite. The solutions which produced these minerals were, according to Doctor Cook, "highly concentrated"; they represented an injection at a definite magmatic stage; and therefore corresponded to Spurr's conception and definition of "ore magma."

Doctor Cook advances the view that the formation of sericite in the wall rock was due to the escape of water and other solvents from this ore magma: and that this withdrawal brought about the precipitation of the molybdenum sulphide. The last stage was crystallization, from the concentrated residuum of the molybdenum sulphide crystallization, of tourmaline and sericite. These were crystallized in vugs: and the existence of vugs further demonstrates (although the author does not point this out) a final non-crystallized residuum of fluid, which filled the now empty spaces of the vugs.

This simple and illuminating example not only illustrates the relation of pegmatite to sulphides, but also of aplites to pegmatites. Many—perhaps most—geologists still thoughtlessly ascribe the difference between the fine-textured aplite and the coarse-textured pegmatite as due to consolidation of a similar magma under different conditions of temperature and pressure. This example—like many others, indeed—shows that this is not so. The difference in texture is due to the difference in fluidity, the pegmatite containing more than the normal amount of volatile elements, as the aplite contains less than normal—less than granite, for example.

Silver and Sarcasm

SARCASTIC WORDS for silver producers are used by an iron and steel publication in a recent issue. Silver has been the alleged victim of "crimes," it says, since the demonetization in the seventies. "No group of people has been more vociferous than the silver producers of our West," it continues. "Many other persons have considered that in some way the treatment of silver as a commodity was an offense against them. In point of fact, the bulk of silver is produced by the big mining and metallurgical companies that have their headquarters in Wall Street."

This cry of "Wall Street" is hard to understand, either literally or figuratively. Has Wall Street any more to do with silver producers than with producers of any other commodity—such as iron and steel, for example? The office of the largest producer of silver—namely, U. S. Smelting—is no nearer Wall Street, figuratively or otherwise, than that of U. S. Steel.

Silver is a commodity, of course. Who says otherwise? Here a suspicion enters that the author of the paragraph was thinking of the Pittman Act. That the Treasury should pay $1 for silver purchased under this act when it was cheaper on the open market was strictly in accord with the text and intent of the law. Any other course would have been illegal and unfair, as a study of the act and its history will show. The misunderstandings that have arisen have been due to ignorance, pardonable or not, depending on the circumstances. In the present instance there appears to be slight excuse. It recalls the remark of Ex-Senator Thomas, recently made at Denver, that east of the Mississippi silver seemed to be anathema.

Straight Tracks

HOW MANY plants have crooked tracks? Some tracks zigzag so, even within a rail's length, that it is surprising that a motor or ladle will stay on them. Oftentimes the motor or the ladle doesn't, and then there is trouble and lost time until things are straightened out again—all except the tracks. They are apt to remain as they were before. Apparently some foremen think that a rail with kinks in it is better than a straight one.

Recently a plant was visited where tracks of marvelous crookedness were seen. Incidentally (or was it incidental?) the tonnage handled by the furnaces was undesirably low. More than one cause contributed to this, it is true; but the trackage was an important factor. A heavy ladle off the track, as frequently was the case, can block things very nicely. A few little kinks in the track may put a big dent into the tonnage.

Nationalization of Mines

WHEN THE COUNTRY IS PROSPEROUS one hears of government ownership. Let a strike cross the horizon, a shortage of some commodity arise, or the failure of an industry to meet the public needs, and there immediately springs up a clamor for government control or ownership, or the nationalization of the industry in question.

The Russian mines have been completely nationalized. The mines produced for a time, but at the expense of known ore reserves, and with little or no effort to develop additional reserves against a day of need. The metallurgical plants were run at full capacity so long as equipment endured the strain. Plant machinery wore out without replacement, as income from the mines went to the Soviet coffers. To maintain production, concessions are now offered to capitalists, but under such terms as practically to prevent exploitation and development.

Another example of government control is that of the United States railroads during the war, returned to their owners in a dilapidated and run-down condition.

Now comes another instance of government ownership in Australia, as reported by our Melbourne correspondent:

"The experience of the State of Queensland should be a warning to any government tempted to start out as mine owners and operators. Some years ago after the Chillagoe company had come to the end of its resources the government stepped in to show how the mines and treatment works ought to be run. To the end of June operations have been responsible for a deficit of about £1,000,000, say $5,000,000. Certainly the government still possesses the 'assets.' The government also operates treatment works (tin) at Irvinebank, on which the accumulated losses amounted to £41,610. The Jibbenbar arsenic mine tells the same story, with an accumulated loss of £15,886, but, as a set-off against this, cheap arsenic has been supplied to pastoralists for eradicating the prickly pear.

"Queensland possesses wonderful deposits of coal, and as private colliery proprietors were not developing the mines quickly enough, the government opened up mines at Bowen, Baralaba, and Styx River. Then the government purchased the Mount Mulligan colliery from the Chillagoe company, primarily to supply fuel for the northern railways and coke for the Chillagoe smelters. The total liability of the state mines stands at £67,051.

"A consideration of these facts leads to the conclusion that it is better to encourage private enterprise, and, if necessary, to subsidize it, than for the government to take the risk. All experience leads to the conclusion that, if private enterprise cannot see any prospect of a return, the chances of a government doing so are still more remote."

Mosquito Engineer

ALL HAVE HEARD of mosquito fleets; also that there are men engaged in sanitation and public health problems whose specific work it is to exterminate mosquitoes. The term "mosquito engineer" is a recent designation applied in the Chicago sanitary district to those U. S. Public Health officers engaged in lessening the activities of this pestiferous insect. General Gorgas, of Canal Zone fame, was perhaps the first mosquito engineer, for in Chicago the Gorgas Memorial Institute is the headquarters of mosquito engineering, whose engineers work in co-operation with the State Health Department. Mosquito engineering is attaining the status of a distinct profession. A town, a community, a private individual need no longer attack the problem haphazardly, as the mosquito engineer is ever ready to furnish accurate, scientific service. Regardless of the name of the profession this new "engineer" is doing good work, with much yet to be accomplished.

This appellation, like so many others, would seem to stretch the term "engineer" beyond its elastic limits, for in the generally accepted definition the engineer deals with forces of nature, such as gravity, inertia, momentum, light, heat, sound, and electricity, and their mechanical application in a multitude of ways. If we designate this new variety by the initials "M.E.," it encroaches upon an abbreviation long in use by the mechanical engineer; should the initial letters be reversed as "E.M.," it will conflict with the engineer of mines, or the older term, *equitum magister* (Master of the Horse). Why not use a name more nearly expressing his duties, as "mosquito exterminator," abbreviated M. Ex.?

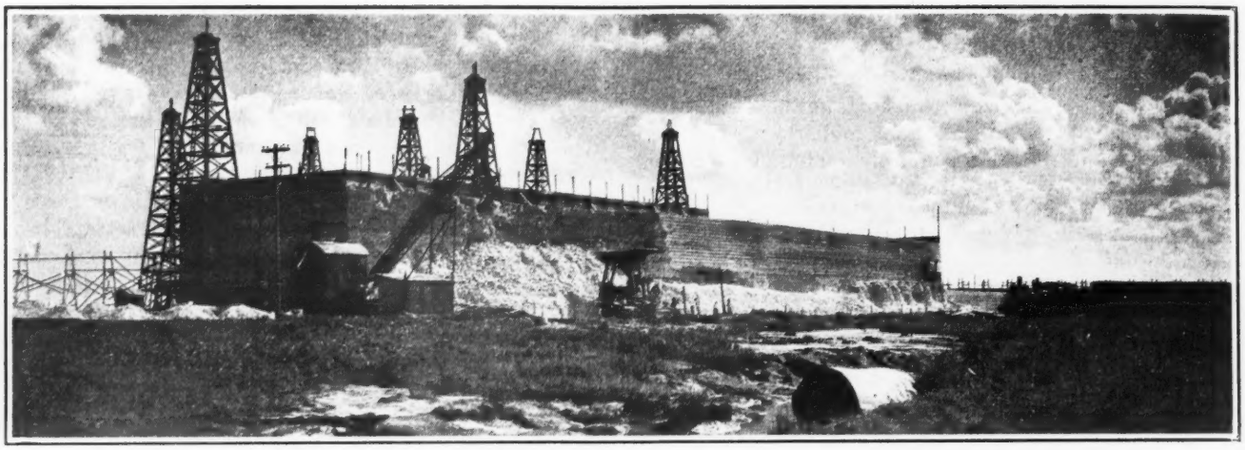
Comstock Merger and the Drop in Silver

CESSATION OF OPERATIONS by the Comstock Merger Mines, Inc., at Virginia City, Nev., is to be greatly regretted, but the wiping out of the narrow operating surplus by the drop in silver prices left no other course for the company to pursue. Comstock Merger, it will be remembered, was diligently exploring the Middle Mines group when the United Comstock was nearing the end of its spectacular career. No very decisive results had been obtained by Comstock Merger from its exploration work. More or less low-grade ore had been exposed and a considerable sum had been spent. At this time the company had two alternatives, one to construct a mill and trust to better results by further exploration work and the other to relinquish its operation. United Comstock was ready to go out of business and offered its property, equipped with a modern mill, to Comstock Merger at salvage prices. Under the circumstances it was considered to be a good gamble, and Comstock Merger took it up.

Production from both properties was maintained and about 950,000 tons was milled. Close, selective mining was necessary, as orebodies were comparatively small and scattered over a great distance. By skillful management operating costs were kept within the limits of expectation, but ore grades proved disappointing and lower than were indicated by careful sampling. Sampling methods followed practice developed by the company in its Mexican operations, which were successful. However, as it proved, after stoping operations were under way at Virginia City, ore grades did not correspond to sampling results, thus indicating that sampling methods were inaccurate. The loose character of the old stope fills prohibited vertical development, and samples taken in horizontal workings only indicated the grade of the material extracted therefrom. There is in this experience a warning note to mining engineers who may be called upon to examine old properties.

An operating margin of about 25c. per ton was maintained and persistent exploration for the discovery of new orebodies was initiated. This was part of the gamble and a risk that experienced mining companies would generally take. No orebodies were found, although a large amount of exploration work was done. Such work could not go on indefinitely, and the drop in silver prices brought on the crisis that resulted in cessation of operations.

Comstock Merger went down with colors flying. Its stockholders and management took a miner's risk and in minerlike way tried to find a mine. An experienced operating force exhausted the facts of the case.



View showing "vat" (stockpile) of sulphur with one side stripped for blasting and loading

Gulf Coast Sulphur Deposits

Discovered in 1869—Shaft Mining a Failure—Frasch Process Solved Extraction Problem—Production 1,500,000 Tons per Year

By Cornelius Kelleher
Superior, Ariz.

SULPHUR was found on the Texas Gulf Coast in 1869. A decade earlier, Drake completed the first oil well in Pennsylvania. Between petroleum and sulphur there was an economic relationship not to become apparent until more than a generation had passed.

This first deposit in Louisiana promptly attracted attention. Several American engineers tried to reach it by sinking a shaft through the soft overburden. These attempts failed. Expensive equipment was imported from Belgium, and a French engineer was retained, who advised his principals, with consummate assurance, that success was easy. The Kind-Chaudron method of shaft sinking was employed. Only a slight depth was attained, when some of the workmen succumbed to the sulphurous emanations, and the enterprise was abandoned.

About 1890, Herman Frasch, chemist, solved the problem, stating, "If we cannot go to the sulphur, we will make the sulphur come to us."

Native crystalline sulphur has a melting point, about 240 deg. F. Frasch's idea was to send heat underground, melting the sulphur *in situ* so that it would flow as a liquid. Water was the vehicle selected to carry the heat. Frasch's idea met with opposition from the engineers he consulted. They pointed out that a source of heat economically possible was not available. The coal regions were at a great distance. How much did he expect his sulphur to cost in competition with the foreign article from Sicily, where brimstone was mined from quarries with cheap labor. The sulphuric acid industry depended largely on pyrite from Rio Tinto, Spain. In 1900 more than 90 per cent of the world's sulphur, exclusive of that derived from pyrite, came from Sicily.

The case was gloomy enough, and remained so for years. Then the oil field at Spindletop, near Beaumont, Texas, was discovered, in 1901. Here, close at hand, was a fuel supply that could be utilized to heat the water cheaply. The application of heat to sulphur mining now seemed feasible.

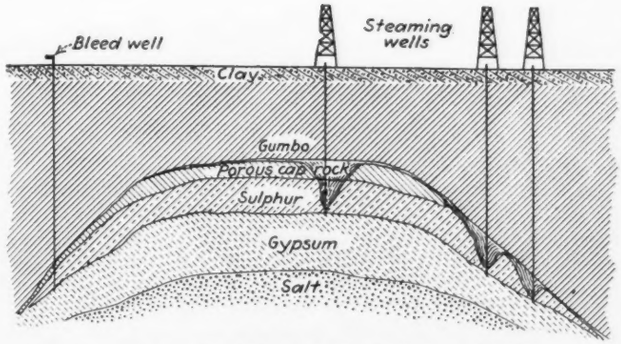
But long before that, in 1894, Frasch had looked on while 500 bbl. of a dark-brown liquid was pumped from his first well. When cool, it was a nice, clean, bright yellow.

Then the mechanical pumping equipment failed, the parts eaten through by the corrosive action of the molten sulphur. Later an air-lift was devised, and this is the method used today.

Mythology says that Enceladus was punished by being buried under Mt. Etna because with his brothers he denied the gods their promised fee. His sufferings, as evidenced by the uneasy life of the volcano, were thought by the ancients to have had something to do with the brimstone deposits in Sicily. At one fell swoop, a savant reduces the European sources to commercial insignificance, and sulphur from the United States dominates the world's markets. It is a triumph of applied science over mythology and like symptoms of the old order.

Now let us consider one of the important domes operated successfully on the Gulf Coast. The country is generally flat, bare of outcrop. The surface topography is distinguished by a slight eminence known as a mound, or colloquially, "the hill." The elevation of this mound is originally perhaps thirty to forty feet above sea-level. The oil drillers penetrated these strange masses. The hole was bottomed in rock-salt. Above this salt is a layer of gypsum. Above the gypsum is a varying thickness of limestone, thickest in the center of the "dome," flaring out thin at the edges. The top of this limestone stratum held oil, the lower part containing native sulphur. At Matagorda, and other places the oil was tapped and drawn off. The presence of the sulphur was ignored, its importance slighted and overlooked.

Wells are now drilled for sulphur alone. The rotary



Ideal section of sulphur dome before subsidence of strata. Slightly exaggerated vertically

drill is used, and the sulphur is reached and passed, and the gypsum below penetrated for a foot or two. The hole is cased through the sedimentary formations with 10-in. or 8-in. casing, and this casing rests on the cap rock. Inside the casing a 6-in. pipe is set in the gypsum. Starting almost at the lower end, this 6-in. pipe is perforated with ⅝-in. holes for a foot or two, to permit the entrance of molten sulphur. Above these perforations, at a joint, a seat or annular diaphragm is fixed in the 6-in. pipe, the opening in the seat admitting a 3-in. pipe which is lowered from the surface until the end projects about 2 ft. below the diaphragm and comes opposite the perforations in the 6-in. pipe. The seat serves as a support for the string of 3-in. pipe, and as a seal which isolates the lower chamber.

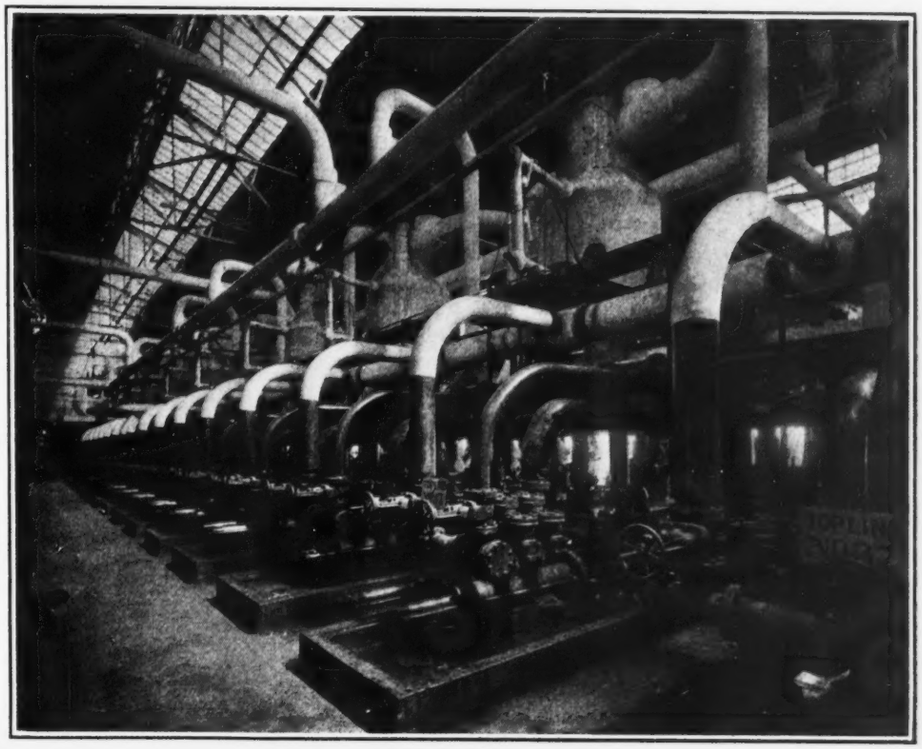
Following up the 6-in. line above the diaphragm, another set of perforations over a vertical length of about 3 ft. is provided. These 1-in. holes pierce the shell all around and may be at 2-in. centers. They form an outlet for the hot water which comes down the annular space between the 6-in. and the 3-in. pipes. The water, as far as possible with nozzle effect, passes out and upward into the porous formation with a head proportional to the height of the column in the well plus any extra pressure that may be exerted by the pumps in the power plant. The formation itself holds groundwater and this should be taken into account. The temperature of the ground-water, before any artificial heat is supplied, is slightly over 100 deg. F.

After contact, the sulphur melts, and being nearly twice as heavy as water, it collects in a sump at the foot of the well and enters the lower perforations. The 3-in. pipe is water-jacketed by the hot water column outside of it and inside the 6-in. pipe. The sulphur rises in the 3-in. pipe to a height determined by the hydrostatic head of the hot water being pumped down, and the relative specific gravity of the two liquids. It does not rise high enough in the piping system to reach the surface. A line of 1-in. galvanized pipe is introduced into the 3-in. pipe. This last and innermost of the concentric pipes carries high-pressure compressed air, which is released in the sulphur column about 20 ft. above the diaphragm that divides the perforations through which the water issues, from the set where the sulphur enters the well.

The sulphur column is thus aërated and made lighter. The familiar principle of the air-lift is established. There are no reciprocating pumping parts to be corroded and destroyed. The sulphur is thus readily raised to the surface, where a sump of suitable capacity, lined with steam coils, receives the production contributed by a group of wells before being relayed to its final destination, the cooling or storage "vat."

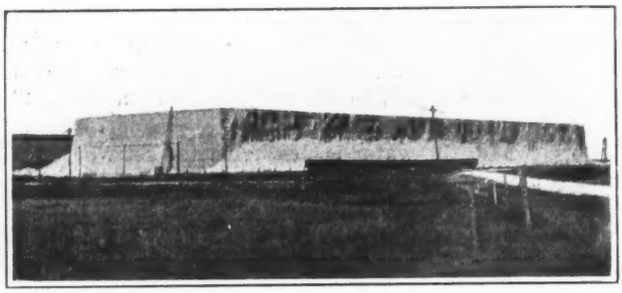
In a sulphur field where small, temporary vats are relied on, the relay station is not necessary. But where there are large permanent "vats," some distance from the steaming area, the air pressure alone will not serve to carry the sulphur stream all the way. From the collecting sump it is lifted by steam-jacketed vertical multi-stage centrifugal pumps, forced through mains hundreds of feet long, and discharged into the permanent "vat." The mains are boxed and carry a 1-in. "gut-line" (as a steam coil) to prevent freezing.

The dimensions of the "vat" provide a large horizontal area over which the liquid sulphur is carefully



Power plant of Texas Gulf Sulphur Co. Mine heaters above cold-water pumps. Behind and to right are hot-water booster pumps

distributed in a thin layer to insure maximum cooling effect. A "vat" is begun on a plank floor, the sides consisting of a board or two nailed to vertical posts. As filling progresses, this sheathing is carried upward around all sides, a few boards at a time, added day by day. As the sulphur congeals quickly on the sides, there is no hydrostatic pressure to be considered. But in the central portions of the block, pockets of molten sulphur will often remain for months, due to the low heat conductivity of an enclosing crust which may at any time form and seal off a pool despite the vigilance of the sulphur "punchers." If such a pool is broken



Two sulphur "vats," one being attacked on two sides. Note talus ready for loading

into when blasting preparatory to shipping, it is dangerous to the operators, and the sulphur may flow away on the ground. When completed, and before blasting, a "vat" is probed by drilling to reveal any hidden cysts of unsolidified material.

Storage "Vats" Contain Finished Product

A finished "vat" is something like 40 ft. high, 800 ft. long, 160 ft. wide. Stripped of its wooden skin, it stands like an immense monolith, yellow, clean, gleaming under a Texas sun, almost 100 per cent pure sulphur. One company alone maintains a stockpile of nearly 1,500,000 long tons. The specific gravity of the "vat" sulphur is about 1.75.

Railroad tracks, parallel to the longer dimension of the "vat," are shifted laterally as loading progresses. On top of the sulphur block, a series of holes is drilled back from the "face" with augers, and the side blasted down with dynamite. As this process is repeated, the "vat" is gradually demolished. The operators are alert to avoid fires from dust and fines, which happen at infrequent intervals, liberating disagreeable volumes of sulphur gas (SO_2). A 2-ton clamshell bucket loads the shattered fragments into the hopper of a box-car loader which feeds into a box car through a flexible chute. If the transportation is interstate and all rail, box cars must be used. Gondolas suffice for shipments to tidewater as at Galveston, thence by ocean-going freighters or tramp steamers to points on the Atlantic seaboard and all over the world.

After the "vat" has been loaded out attention is turned to one newly completed on the other side of the track, and the old site prepared for refilling.

Contrary to an impression in some quarters, steam is not sent underground. Live steam from the boilers, rather wet, at 90 to 100 lb. gage, is admitted to a large asbestos-covered tank called a mine heater, where it mixes with preheated water and, in condensing gives up its latent heat of vaporization. The cold water from the outside reservoirs is preheated by the exhaust from plant auxiliaries to perhaps 160 or 200 deg. F., depending on the exhaust steam available. It varies somewhat with the seasons.

In the mine heater the temperature corresponds roughly to the steam pressure. It is 335 or 340 deg. F., and five to ten degrees are lost in transit to the field. The water enters the deposit at about 320 deg. F. The melting point of native sulphur is 240 deg. F. It becomes viscous again at about 330 deg. F. The molten sulphur at the surface has a temperature of about 260 deg. F. Its specific gravity when molten is 1.81.

The formation will often take the hot water at the power plant pressure in the mine heater. When required, booster pumps, located under the mine heater, can raise the pressure on the outgoing water to a maximum of 250 lb.

A well "blows" when the pool of sulphur at the bottom is temporarily exhausted. The water is now coming back up with the air and flashes into vapor at the reduced atmospheric pressure. The air is hastily cut off, and the well is "boosted" for five or six hours by pumping down water without attempting to raise sulphur until the underground reservoir is replenished, when the air is again turned on and the flow of sulphur is resumed. This process is intermittent, although some wells will pump indefinitely, maintaining a fairly steady rate. Sixteen long tons an hour is good production. The flow proceeds in pulsations, probably due to pistons of air in the sulphur column.

A well that starts off as a splendid producer may have but a short life, for the sulphur it withdraws from below in such a copious stream leaves the rock structure with weakened support. Subsidence, involving all the overlying strata, ensues, and the piping equipment is twisted, ruptured, and often destroyed. It costs about $10,000 to drill and equip a well for steaming. This subsidence is relied on to restrict and close up the vacant spaces above the zone still mineralized that would otherwise be occupied by the hot water to no useful purpose, and consequently would be a source of expense. The hottest water, being the lightest, is always at the top.

The life of a well may be from a few days to one year; in some rare cases, two years. The average life of a given number of wells over an extended period is more nearly measured in days. Seldom does a new well fail to function.

The wells are established in groups, and as losses are sustained due to natural causes, accident or old age, the group is reinforced by recruits. These continual additions cause the producing group to move gradually about the area being steamed in a sort of progression. Pipe lines are laid and taken up to meet the requirements of the changing situation.

The clayey envelope that covers the cap rock is an

Residences in a South Texas sulphur town

excellent seal for the water and the heat. Bleed wells tap the porous sulphur-bearing limestone formation at points on the dome lower than the elevations of the pumping wells, so that the water, after having cooled, may be drawn off to make way for new hot water. This bleed-water brine, as might be expected, has a high mineral content in solution, and is considered "foul." Its temperature is around 110 deg. F.

In the course of time there is a large reservoir of hot water in the dome, and a secondary phase of sulphur melting proceeds. There is then an aqueous level below which the temperature of the water is below the melting point of sulphur, and above which the temperature of both rock and water is higher than the melting point. Above this critical level, no sulphur can exist in solid form, and a melting process goes on with the downward creep of this plane of fusion which supplements substantially the direct action of the wells themselves. A lot of sulphur is melted and remelted many times over. This storage of hot water underground is a tremendous thermal asset, and must not be jeopardized.

The heat efficiency of the whole process is, of course, low. To raise a pound of sulphur from 110 deg. to 260 deg. F., including fusion, takes about 45 B.t.u. Under excellent conditions in practice, it has required a heat input of about 900 heat units to mine a pound of sulphur. The indicated efficiency is around 5 per cent. This has been achieved only in the last few years. One of the south Texas producers has lately changed from fuel oil to natural gas under its boilers, the gas being piped across country from an inland field.

Sulphur mining by the Frasch process is almost automatic in character. The labor employed is relatively small. The most important human intervention, in an established field, is to turn a valve or throw a switch. Quarrying or stoping methods cannot prevail against it, but it can be applied, of course, only to a subterranean deposit. After mining has continued for some years, the mound gives place to a sink, due to subsidence of the strata as the sulphur is removed from below. In the rainy season the sink forms a lake unless drainage is provided. The volume of the sink exceeds the volume of the sulphur extracted, from which it is inferred that the soft gumbo flows into and occupies the fractured limestone.

What has happened in the American sulphur industry may be epitomized by pointing out that the domestic production has risen from a negligible quantity in 1900 to 350,000 long tons in 1908, to 750,000 tons in 1912, and in recent years to approximately 1,500,000 long tons per annum. The Sicilian production, disrupted by the war, is subordinate to American sulphur in the markets of the world, and some time ago a working agreement between the two major international interests led to an understanding conducive to the creation of stabilized trade conditions both at home and abroad.

Bureau of Mines Active in Last Fiscal Year

CONTINUATION of the safety campaign among the million miners of the United States was the predominant feature of the activities of the U. S. Bureau of Mines during the fiscal year 1926, the first year in which the Bureau functioned under the Department of Commerce. The campaign was also extended to the workers in the petroleum and natural gas industries.

Actual production of shale oil was begun at the experimental oil-shale plant established near Rulison, Colo. There American-type and Scottish-type retorts are now being operated for purposes of comparison.

Helium production plant No. 1, near Fort Worth, Tex., was transferred during the year from the Navy Department to the jurisdiction of the Bureau, which is conducting an intensive search for sources of helium. A government helium reserve was established to include the natural-gas structure at Woodside, Utah, in which helium gas has been discovered. A helium purification plant designed by the Bureau was turned over to the War Department.

The Bureau continued its study of the causes of mine fires and explosions, furnishing reports to the mine operators following investigations of disasters at their mines. In many places metal-mine workers are seriously menaced by harmful dusts and lack of ventilation. The Bureau is studying ventilation conditions in various metal mines throughout the country. Chemists at the Pittsburgh experiment station have developed a new respirator which is believed to be superior to other devices as a means of protecting wearers from injurious dusts encountered in mining and other industries. Studies conducted in co-operation with the United States Public Health Service and the American Society of Heating and Ventilating Engineers are affording information relative to temperatures and air-movement conditions which afford the best safety and efficiency conditions in mines and factories. Sanitary surveys of mining towns in various parts of the country have been made by Public Health Service officials attached to the staff of the Bureau of Mines. A study of the serious problem of pollution of streams by waste waters from mines is being conducted. Health hazards in the use of ethyl gasoline were investigated.

Studies were conducted looking toward the utilization of vast deposits of low-grade iron ores in Minnesota, Alabama, and elsewhere. Efforts to improve metallurgical practice to utilize deposits of low-grade lead, zinc, and copper ores were also studied at the Bureau's experiment stations. The application of oxygen or oxygenated air to metallurgical fields and problems is being investigated. Development of such processes, depending on methods of the cheap production of oxygen, would effect considerable savings in many metallurgical processes.

At its New Brunswick, N. J., experiment station, the Bureau devoted some study to methods for the utilization of small limestone fragments now wasted at lime plants. Better methods for the mining and preparation of mica are being investigated.

During the year a survey was made in several states of leakage in natural gas transmission lines, and immense savings were found possible by testing and repairing the lines. In the Powell oil field, in Texas, an increased production of 1,000,000 bbl. of oil was attained from wells repaired under the supervision of Bureau engineers. The Bureau is studying the problem of increasing the recovery of oil from depleted sands, it being estimated that 80 per cent is not recovered.

Sixty-six Years Ago on the Gogebic Range

The First Prospectus—Early Faith in Its Future—Pioneer Enterprise on Penokee a Failure

By Dwight E. Woodbridge
Mining Engineer, Sellwood Building, Duluth, Minn.

I HAVE BEFORE ME as I write a pamphlet issued in the year 1860 on the "Penokee Iron Range," with special reference to the properties of the pioneer mining enterprise of that great district now called the Gogebic. That precursor to the later activity of the region was the Wisconsin & Lake Superior Mining & Smelting Co., which was organized under an act of the state legislature passed in 1856. In its charter it was granted a capitalization of $500,000, to be increased to $1,000,000 if desired and in case certain formalities were observed. Its incorporators were William P. Young, John Cummings, John Lockwood, J. P. Gurney, and A. M. Barringer, and its officers were E. Palmer, president; H. Hill, vice-president; R. B. Bell, treasurer; and J. F. Hill, secretary. Some of these names are familiar to mining men of Lake Superior, but most of them are not. It owned 1,960 acres of land along the Penokee range, including 2½ miles on both sides of Tylers Fork at the gorge, a mile lying just north from Mount Whittlesey, and half a mile where Bad River breaks through the range at Penokee gap. All this area lies between the fourth principal meridian and Lac des Anglais, a name now Anglicized. It all is in that part of the Gogebic in which the iron formation is characterized by crystalline banded rocks consisting of magnetite, quartz, amphiboles, and other silicates.

Early Reports Comprehensive

In the light of what is now known of the Gogebic district after more than forty years of exploration and mining, the statements made in this first Gogebic mineral prospectus are interesting. Dr. I. L. Lapham, who afterward was state geologist of Wisconsin, made a report to the company that was printed in this little book, and from which I take these extracts:

"It will be seen that we have discovered already good ore in such quantities as to be practically inexhaustible, situated at points accessible to water power and having bold fronts, rendering it comparatively easy to be quarried. For years to come only the richest and most accessible ores can be brought into use. . . . It must not be supposed that this ore constitutes a continuous workable mine throughout this whole twenty miles; it is only where the ores are easily worked and water-power is at hand that very great immediate value can be put upon these lands. . . . The immense quantity of one of the most valuable iron ores existing in beds so accessible, so near Lake Superior, . . . must sooner or later become the source of great wealth."

Doctor Lapham stated that assays of this ore showed as follows: Fe, 58.13 to 68.08 per cent; SiO_2, 18.6 to 9.65; magnesia and other materials, 0.8 to 0.85. He also gave the cost of iron ore from the Marquette range as of the year 1858 as follows:

Cost of quarrying the ore	$0.50
Freight to Marquette	.75
Dockage at Marquette	.38
Freight to Lake Erie	2.50
Cost per ton delivered	$4.13

In 1848 all this region was a trackless wilderness; in the next year Charles Whittlesey made a geological study of the territory in Wisconsin bordering on Lake Superior and described the "magnetic ore beds of the Penokie range." He quotes analyses of from 56.3 to 66 per cent metallic iron, and makes this statement:

"The bed of magnetic iron south of Lac des Anglais is of extraordinary thickness, 25 to 60 ft. . . . In the wild and deep ravines where Bad River breaks through there is a cliff of slaty ore probably 300 ft. thick. I estimate more than one-half of this face to be ore."

In this prospectus is a geological map of that part of the range running west for about 20 miles from the fourth meridian; that is, from the east side of Range 1, west to English Lake, 20 miles. This was prepared by Whittlesey, Edward Daniels, and Lapham; in it the crest of the range and its iron outcroppings are shown with remarkable accuracy. This map, the first ever drawn of that district, was a wonderful achievement in the face of the difficulties that must have been encountered.

Topography Outlines Archean Rocks

As one stands today on some eminence of the iron formation, say just above the city of Hurley, and looks about him, the course of the Gogebic is marked by its distinctive topography as clearly as though drawn by a pencil upon a map. The swelling hills and the smooth, sloping valleys, like "far Monadnock, softened to a gem," outline with precision the course of the Archean rocks and the underlying quartz slate of the ore member, of the eroded slates of the hanging wall, and of the more distant overflows of the Keweenawan. It is no trouble to follow the course of these rocks. But how different when there were no sightly outlooks above the forests, when there were no settlements affording bases from which to operate, no railways to suggest transportation or development; nothing but the scientific mind and the prophetic eye with which to read what was to come, and in the fluid of the future to watch the crystallization of progress.

The Wisconsin & Lake Superior company did not succeed in the financing that this prospectus asked. At Tylers Fort is an old shaft sunk by it, and some open cuts exposing the formation; and some small pits at Penokee Gap are attributed to it. But it lost heart and succumbed. Pumpelly and Brooks in 1872 briefly described this part of the range, and fuller accounts of the Penokee-Gogebic district were given in the reports of the Wisconsin Geological Survey between 1873 and 1879. In 1880 soft hematite ore was found by Nat Moore near what is now the city of Ironwood, and the development of the Gogebic began.

Within the last few years, and until a year ago, a costly exploratory campaign was carried on at Penokee Gap and toward English Lake, on the very locations of which Mr. Lapham spoke so highly in 1858. Elaborate experiments have been made on the magnetites there cut by drills to determine what might be done with them. So far as known, these operations have resulted negatively; at any rate, the district has subsided to quiescence. At Mount Whittlesey, on other lands that were owned by this old company, a large sum has been spent in an attempt to concentrate the lean ores existing there. This work, also, has ceased, even so far as it attempted to make crushed rock for railway ballast. Probably it will be many years before these rocks will be attacked again with the view to mining iron ore.

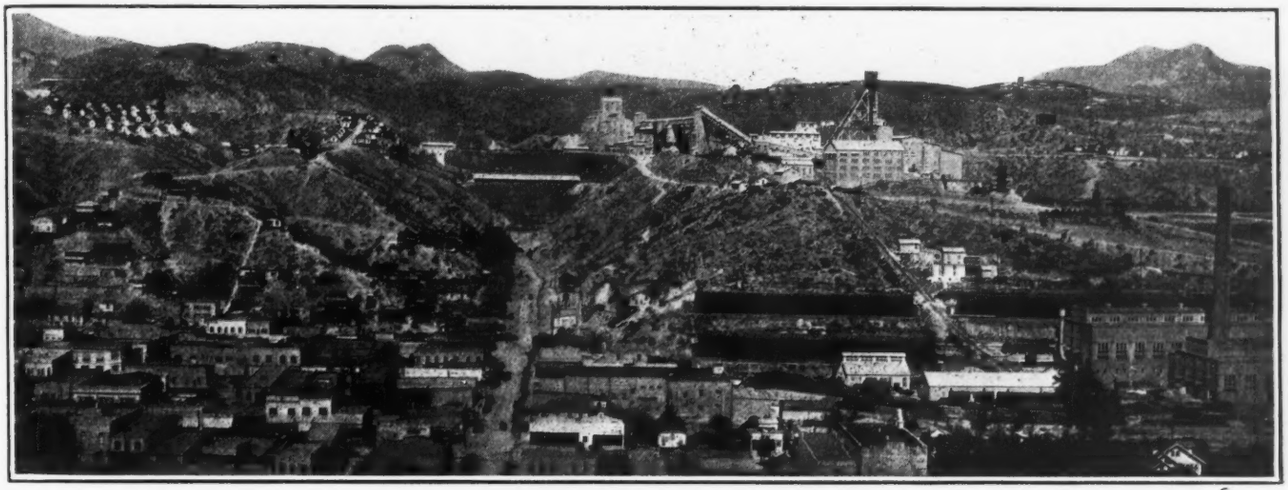
Mining Camps of North America

Globe-Miami: Leading Copper Producer in Arizona

Successful Methods of Caving Low-grade Porphyry—Miami Copper Co. Pioneered—Inspiration Has Good Record—Efficient Metallurgical Treatment

By Cecil M. Cooper
Metallurgical Engineer, Miami, Ariz.

THE Globe-Miami district is to be credited with one-fourth of the copper produced in Arizona, the greatest copper-producing state of the United States, and accounts for about one-tenth of the United States' production. This great old camp, whose voluminous and varied history contains a vivid chapter on conditions of the "old West," though once an important silver-producing district, has within the last fifteen years gone over to the newer style of production and has taken up the exploitation of the "porphyry coppers." The ravaging of huge bodies of low-grade disseminated ores of copper accounts for more than nine-tenths of the camp's present production.



The town of Miami, looking north

The power plant of the Miami Copper Co. is in the right foreground, the Miami main shaft, crusher and ore bins above the concentrator are seen in the middle-ground. The top of the caved area over the Miami mine can be seen to the left, and slightly back of, the tailings dam across the gulch in the center. Inspiration's pit is seen in the left upper corner. The Inspiration town site can be seen just below the sky line in the middle background of the photo.

Typical Mountain-Desert Country

Globe and Miami, 7 miles apart, are situated in southeast-central Arizona in the heart of the mountain region of the state. The region is the central of the three physiographic belts of Arizona, designated as the plateau, the mountain, and the desert regions, by the U. S. Geological Survey. These towns are reached from the southeast by a branch-line railroad 120 miles in length, which connects with the Southern Pacific main line at Bowie. Three or more excellent highways also tap the district from as many directions. Two of these form inlets for produce and supplies from the fertile Salt River Valley, of which Phoenix, 86 miles west of Miami, is the metropolis and main center of activity. One of these highways, established for many years, is the Apache Trail, which has become nationally famous for the scenic wonders of the rugged, mountainous country which it traverses. Its route lies, for a considerable distance, along the canyon course of the Salt River, past the Morman Flat and Roosevelt dams and lakes, where are situated two irrigation and hydro-electric projects which furnish most of the water for irrigation and electrical power for central Arizona.

Globe and Miami, with a combined population of 22,000, lie in a shallow mountain valley, at an altitude of 3,500 ft. between two ranges, the Pinals to the west and the Apache range to the east, and except for a narrow pass to the southeast these towns are entirely surrounded by rugged country. The seasons are decidedly dry. Sudden and violent summer showers, which are always accompanied by fierce electrical displays, and occasional long-drawn-out winter drizzles, which sometimes turn to light snows, comprise the area's total precipitation. The mean annual temperature is about 65 deg. F., with a range of from about 20 deg. at the coldest times to 108 deg. on the warmest of summer days. Even 108 is not oppressive in this arid climate. Vegetation is sparse, consisting of the usual forms of arid, mountainous regions of the Southwest.

Earlier Work of U. S. Geological Survey

This district is one of the classic areas of the West that were correlated and mapped a quarter of a century and more ago by the U. S. Geological Survey. The Globe quadrangle was surveyed in 1902 by F. L. Ransome, who of late years has resigned from the Survey and is now professor of economic geology at the University of Arizona. Later, in 1911 and 1912, Dr.

Ransome revisited the district, subsequent to the discovery and opening up of the low-grade bodies of disseminated copper ores, and made additions and corrections to his former work and had published Professional Paper 115, of the Survey.

The rock section of the Globe-Miami area consists of a Pre-Cambrian complex composed of schists, granites, and diorites, overlain by Paleozoic sedimentaries, chiefly Cambrian quartzites and limestones and Devonian and Carboniferous limestones. These are intruded by acidic and basic rocks, and the whole series is capped by Tertiary extrusives.[1]

Detrital deposits of Quaternary age fill in old valleys and erosion channels, and in places reach great thicknesses. The Pre-Cambrian and Paleozoic rocks are pierced by at least three distinct bodies of acidic intrusives, ranging in composition from diorite to granite. The oldest of these intrusions is referred to Cretaceous, or earlier, times; the younger intrusions are considered to be of Tertiary age. Immense sheets of diabase of Mesozoic age also cut the Pre-Cambrian and Paleozoic rocks. The Tertiary volcanics consist principally of a thick flow of dacite, which has been estimated to have been at least 1,000 ft. thick originally, and minor flows of basalt. In contrast to other regions where Tertiary volcanics are common, no ores of importance have been found in the dacite. The sources of all ores of the district are considered to have been the intrusives, both acidic and basic.

The ore deposits consist of filled fissure veins and their variations, replacements in limestone, quartzite and diabase, and secondarily enriched disseminations in shattered Pre-Cambrian and intrusive rocks. Vein and replacement deposits, which were worked exclusively in the early days, have lost their importance as producers, but one important mine, the Old Dominion, and three smaller ones are still operating on vein deposits.

Attention was first attracted to the area by bonanza silver ores. These deposits occurred as replacements in limestone and quartzite and in irregular shoots in fissures. The gossans of vein deposits of copper ores were in some cases rich in silver. The Old Dominion mine was first worked for silver, copper ore being discovered with depth. These deposits of silver ores were found to be erratic, small, and shallow. Three or four of these deposits were worked to depths of 800 or 900 ft., and attained productions of some hundreds of thousands of dollars, but were worked out in a few years. Gold occurs with the silver and in some of the ores of copper, but to a very limited extent, usually. Ores of lead and zinc are found in one small portion of the district, but these deposits seem to be of limited extent, and as yet they have not been explored comprehensively.

Disseminations in Schist

The deposits of disseminated ores of copper occur principally in intensely shattered Pre-Cambrian schist near the contact of this rock with intrusive granite. This ore is of two kinds, representing different stages in the process of supergene alteration and enrichment, and consists of secondary chalcocite enrichments of a protore consisting of occasional specks of chalcopyrite in the shattered rock, and, where alteration has proceeded further, mixed chalcocite and oxides. Small areas of the intrusive granite itself, where shattered and adjacent to the contact with the Pre-Cambrian rocks, contain commercial ore. Though miles of this contact zone between schist and intrusive are exposed, only small portions contain copper ores of any extent. The only portion that has proved to be of commercial importance, so far, is what is known as the Miami-Inspiration orebody, which is contained in an area approximately 2½ miles long by ½ mile wide. An area several miles away, but occupying a similar position with respect to formations, is being actively explored at present and is apparently impregnated with copper ores, which, when thoroughly explored, may be found to be of sufficient extent to be of commercial importance. The ore in these disseminated orebodies ranges in grade from 0.6 per cent sulphide copper up to 3.0 per cent, with minor percentages of oxides, except for mixed ores which carry varying proportions of sulphide and oxide copper, but contain the same total percentage of copper as sulphide ores. The amount of 3.0 per cent ore is small in proportion to the amount 1.5 per cent material, and there occur large quantities of 0.5 per cent material, which is at present of no commercial value.

A part of the asbestos deposits of Gila County, which are the largest in the United States, occur within a few miles of Globe, and the chief asbestos districts are only from 30 to 50 miles north. These deposits occur at the serpentinized contacts of limestones with intrusive sheets of diabase.

Scene of Indian Romance

This section of Arizona is the home of the Apache Indians, that fierce and treacherous tribe that once taxed the courage, hardyhood, and resourcefulness of the most sanguinary and accomplished of our Indian fighters of the early days, and which has won a prominent place in the Indian history of our Southwest. Such noted warriors as Geronimo and Victorio once used the desolate fastnesses of this region for their retreats. Here they long eluded the government soldiers and directed raids upon the white settlements in the valleys to the east and west.

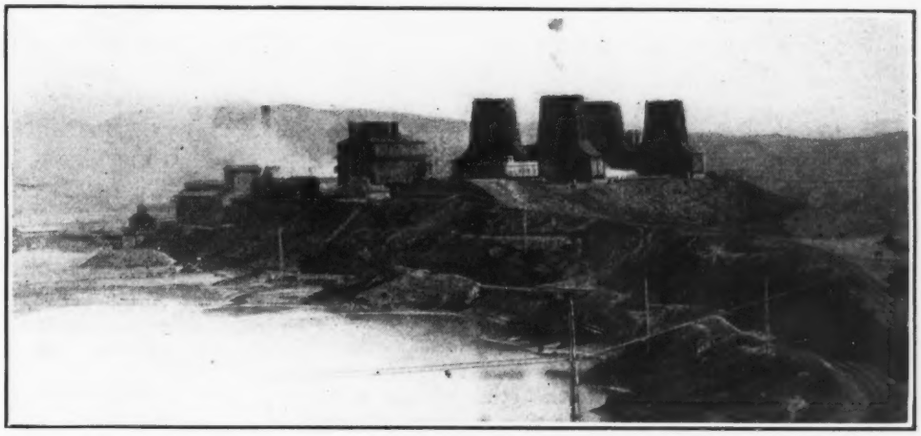
Ore was probably first discovered in the Globe area in 1870, when a partial subjection of the hostile redskins induced straggling parties of prospectors and explorers to enter the rugged desolation of this mountainous region.[2] The first recorded claim locations were made in 1873 by a party of prospectors which entered the region from Florence, a small town on the Gila River 55 miles to the west. These claims, the Globe and the Globe Ledge, though for several years little attention was given to them, later were destined to become the basis of the operations of the Old Dominion company, which was for twenty years or more the most important mine operator in the district. More attractive discoveries of silver ores, made about the same time or slightly later, drew all of the interest for several years. The first camp to spring up was founded by Henry Ramboz in 1875, near Ramboz peak, about four miles northeast of the site of the present town of Globe. Soon after this a number of camps sprang up in the surrounding mountains where rich bodies of silver ores were found. Among these were Richmond Basin, McMillanville, Cottonwood Springs, and Pioneer, each built up about some glorious silver mine, of which little but the name and memories now remain. Globe came into existence some time prior to 1878, when Ramboz

[1] F. L. Ransome, Globe folio, and Professional Paper 115, U. S. Geological Survey.

[2] McClintock's history: "Arizona, the Youngest State."

camp was transferred to a more favorable site on the banks of Pinal Creek. Records show that by 1883 twelve mills were treating ores of silver and gold in this area.

Silver mining, however, had reached its zenith, and thereafter declined rapidly. Now practically no silver is mined, and nothing remains of the once flourishing silver-mining epoch except the weird ghost-camps, with their rotted buildings, forgotten graves, and the caved entries and brush-grown dumps of the short-lived bonanzas. Statistics on the silver production of this epoch are almost completely lacking. During the early years of activity in this area the future prominence of copper production was unsuspected, and indications or occurrences of copper ores were given but little attention. In the later 70's and earlier 80's, however, a recorded interest was aroused in copper with the discovery of high-grade copper ores on the Globe and Globe Ledge claims, near Globe.



The International smelter

Here are treated the products of the mines and mills of the Globe-Miami district. The huge towers are cooling towers of the Inspiration power plant, which is concealed by them.

Old Dominion Organized in 1880

The original Old Dominion company, which was the first to exploit copper ores in the district, was formed in 1880, and a small copper furnace was erected by it at this time to treat oxidized ores. By 1884 this furnace had produced 490 tons of copper, and by 1886, a total of 11,000 tons had been produced. At this time six copper furnaces are reported to have been in operation in the district. Also, the Old Dominion company first changed hands. Since, the company has been reorganized several times, and the mine has been idle for short periods, but for thirty years, subsequent to the short flourish of silver production and prior to the opening up of the "porphyry coppers," it was the main enterprise and the backbone of the camp. At present the Old Dominion is producing 25,000,000 lb. of copper annually and has under way plans of development which will open up its orebodies to the twenty-sixth level and extend the life of the mine over a period of years.

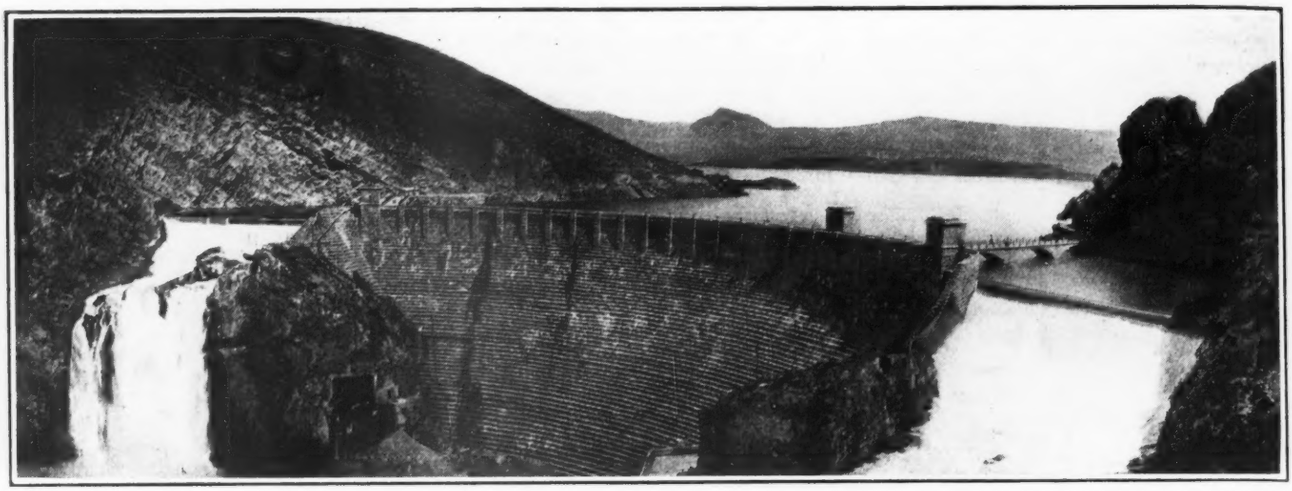
The history of mining at the Old Dominion is an account so replete with records of mining feats and of battles won over obstacles as to thrill the most prosaic and hardened miner. The orebodies occur along the Old Dominion fault, a complicated hinge fault zone along which there have been succcesive and unequal movements. The first movements are attributed to Mesozoic times, and the latest have displaced the Tertiary dacite capping. In this area the ore occurs as fissure fillings and as replacements of the quartzite, limestone, and diabase walls. The original positions of these orebodies have been changed by cross faulting of a complicated nature. In width, the oreshoots vary up to 70 ft. and the most persistent in length is 1,500 ft. long. The complicated fault structure was perplexing to early operators, and much useless work was done in exploring in the wrong direction. Many openings were pushed out into the shattered and porous formations of the hanging-wall side which underlie Pinal Creek. These workings tapped a source of immense quantities of water, which, during wet seasons, finds its way down into these formations from Pinal Creek. This hazard has more than once threatened the life of the mine and has been one of its greatest operating problems.

Mine Pumping Big Problem

An account of the pumping problems and practices of the Old Dominion mine, by P. G. Beckett, is contained in the *Transactions* of the American Institute of Mining Engineers for 1916, Vol. 55, pp. 35-66. Mining methods at the Old Dominion consist principally of two types. In the eastern portion of the mine, where the ground is firm, top-slicing methods are in use, while in the wet, heavy ground of the western portion square-setting is resorted to. Approximately 60 per cent of the ore production comes from the former type of stoping. Down to the tenth level—a vertical depth of 600 or 700 ft.—the ores were oxidized, but below this point sulphides predominate. The practice of direct smelting, long the method used, finally gave way to the dual process of concentrating and smelting, on lower grades of ore. The eventual working out of high-grade smelting ores, however, together with the expense that would have been required in remodeling and rebuilding the company's smelter, to bring it up to modern standards and make it suitable for the treatment of flotation concentrates, finally terminated the operation of the Old Dominion smelter on Jan. 30, 1925. Thus the black stack which, for more than forty years, emitted smoke above the town of Globe, and gave assurance to all of the importance and permanency of the community, is now merely a gaunt but fitting monument to the industry of a glorious past.

Concentrate Goes to International

The products of the Old Dominion mine now go to the International smelter, at Miami, for treatment. Simultaneously with the closing of the smelter, plans were undertaken for remodeling and enlarging the concentrator to 1,500 tons per day. In efficiency and



Roosevelt Dam and lake on the Salt River

This project supplies the Salt River Valley with water for irrigation, and has transformed a scorched, arid waste into a marvelously productive and beautiful garden spot.

extraction it is on a par with the other plants of the Phelps Dodge Corporation, in whose control the Old Dominion now rests. The ore is reduced to pass a 65-mesh screen by means of gyratories, Symons disks, rolls, and Hardinge mills. Potassium xanthate, pine oils, and lime are used as flotation reagents, and the pulp is submitted first to K. & K. flotation machines and then to pneumatic machines. Mill heads assay about 4.0 per cent copper, principally in the form of chalcopyrite, and 19.0 per cent iron. A concentrate assaying 16.0 per cent copper is obtained. Of particular interest at the Old Dominion concentrator at the present time is a new type of pneumatic flotation machine invented by D. L. Forrester, and perfected and patented by the company. The outstanding feature of this machine is the elimination of a porous medium, or blanket, for the dispersion of air. It is reported to be a decided success with an increase in efficiency over other machines and a decrease in operating and repairing expense.[3] W. G. McBride is general manager of this company; I. H. Barkdoll, mine superintendent; and D. L. Forrester, mill superintendent.

J. P. Channing Sees Possibilities

The commercial possibilities of the Miami copper deposits, though suspected for a great number of years prior to the beginning of their exploitation, were first brought into prominence in 1906 by J. Parke Channing, who was then consulting engineer for the General Development Co.[4] Mr. Channing visited Globe during the winter of 1906, at which time his attention was called by a fellow engineer to an area of rusty colored hills six miles west of Globe. Mr. Channing was acquainted with the disseminated copper deposits in Bingham Canyon, in Utah, at McGill, Nev., and at Morenci, Ariz. He visited the Miami area, was struck by the presence of the same geological conditions as prevailed at these other copper deposits, and took an option on a group of claims for the General Development Co.

Subsequently two shafts were sunk simultaneously, on what are now the Captain and Red Rock claims of the Miami Copper Co. Both were started in iron-stained and silicified schist, though the type of alteration at each shaft was somewhat different from that at the other. One shaft passed out of the schist at a depth of 100 ft. into granite, showing only occasional specks of chalcopyrite. The shaft was stopped at a depth of 200 ft. without having struck ore. The other shaft was also sunk in the schist to a depth of 200 ft. without striking ore. However, at this point, in April, 1907, this shaft penetrated a zone of secondary enrichment and entered 3.0 per cent ore. A year later 2,000,000 tons of this grade of ore had been blocked out, and the shaft was 710 ft. deep. At this time the Miami Copper Co. was incorporated with a capital stock of 600,000 shares at a par value of $5 each, half of this stock being retained by the General Development Co. and 200,000 shares being sold at par to finance operations. From this beginning the Miami Copper Co. eventually blocked out some 25,000,000 tons of ore averaging from 2.25 to 3.0 per cent copper, and 67,000,000 tons averaging 1.01 per cent copper. The Miami company got the cream of the Miami-Inspiration orebody, though this ore was then considered to be of very low grade. But this company evidently failed to take advantage of its early opportunities to include within its holdings the less promising extensions of its orebodies. No doubt, the Miami company felt that it had all that it could properly handle.

Inspiration's Ore Reserves

Another company, coming some five years later than the pioneer Miami company, and wider in the scope of its operations, obtained the principal part of the then uncertain extensions of the Miami orebody. The Inspiration Consolidated Copper Co. was incorporated in Maine in December, 1911, with a capital stock of $30,000,000 divided into shares of $20 par. This company was formed to take over the holdings of two older companies, the Inspiration Copper Co. and the Live Oak Development Co. In 1914 this company purchased the holdings of the New Keystone Copper Co., comprising 219 acres of ground lying between the Inspiration and the Live Oak groups. This gave the new company about a mile and a half of the northern extension of the Miami ore zone. Miami's holdings comprise the southern end of this ore zone. This end terminates abruptly at

[3] D. L. Forrester, *Engineering and Mining Journal-Press*, Vol. 120, Sept., 26, 1925, p. 492.

[4] T. A. Rickard, "Miami, the Discovery," *Mining and Scientific Press*, Vol. 115, p. 157. Also "Miami, the Mining of Ore," p. 417, "The Milling of Ore," I, p. 565 and II, p. 679, and "The Smelting of Ore," p. 784.

a fault which has brought a Quaternary detrital conglomerate down against the ore-bearing schist. The throw of this fault is at least 2,000 ft., and many efforts have been made by the Miami company and other parties to locate the southern extension of the Miami orebody beneath this conglomerate. Miami's explorations have ceased, presumably without any satisfactory results.

The surface indications of the Inspiration ground were not so promising as were those on the claims acquired by the Miami company, and subsequent drilling proved the main portions of Inspiration's ore to carry 1.5 per cent, or less, of copper. About 55,000,000 tons of this ore carried 0.9 per cent of copper in sulphide form with 0.3 per cent as oxides, and this comprises the milling ore. An orebody comprising approximately 45,000,000 tons contains the copper in mixed form. This ore carries from 0.4 to 0.8 per cent of copper as sulphides and a similar percentage in the form of oxides. The solution of the problem of treatment of this latter material consumed a period of seven years, the efforts of some of the best metallurgists in the country, and, it is reported, $1,500,000. It was finally solved, however, and a 7,500-ton leaching plant has just been completed to treat this ore. This plant has cost more than $6,000,000.

Branch Raise Caving Developed

The mining methods of the Miami and Inspiration companies are unusual, though by no means entirely original. From the start, the success of these projects depended largely, of course, upon the perfection of methods of mining huge quantities of material rapidly, and at a correspondingly low cost. The capping over the orebodies ranges in thickness from 100 to 800 ft., making steam-shovel operations out of the question. The Miami company originally used two methods: (1) top slicing for the ores of higher grade where it was important to extract all of the ore clean; and (2), block caving, used on ore of lower grade on which a 100 per cent extraction and exclusion of all waste were not of prime importance. With the working out of Miami's high and medium grades of ore, however, a still cheaper method was necessary for the profitable treatment of 1.01 per cent ore which is now being mined. The method in use upon this ore is said to resemble the Inspiration system.

The Inspiration system was introduced at the Inspiration mine by Felix McDonald, mine superintendent. It is a caving system by which the orebody is undercut and started to cave by means of a system of branching inclined raises, the branches multiplying upward. The upper terminations of this system of raises are "fingers" whose upper ends come so close together as virtually to perforate a horizontal plane through the orebody, or at the base of it. When rounds of drill holes are placed in the upper ends of these fingers and blasted, the ground between the fingers is broken and caves, thus undercutting the ground above. The caved ore is drawn off, under control of manually operated chutes, through the raises below, and finally finds its way into main loading chutes. The principles of this method were formerly used at the mine of the Ohio Copper Co. in Bingham Canyon, Utah. This system and the systems formerly used by the Miami company have found thorough elucidation in current mining literature.[5]

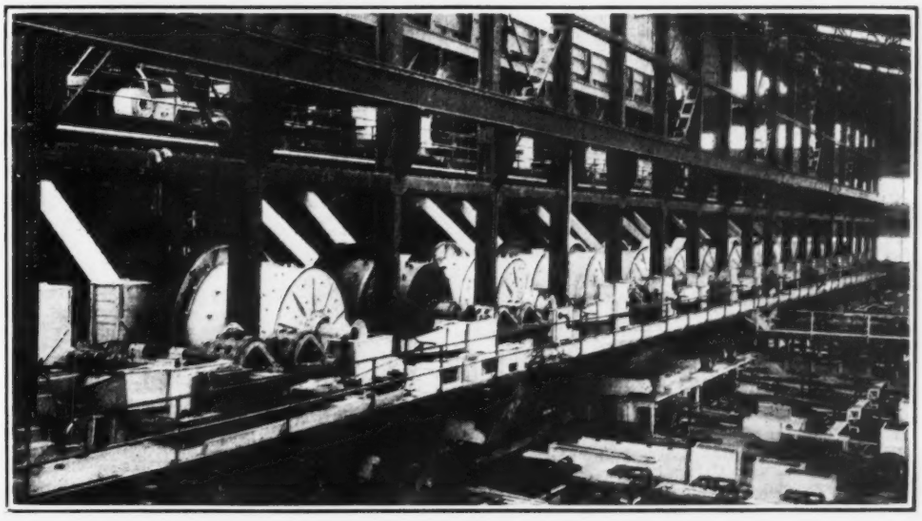
The history of milling by these two companies is very closely connected with the development of the flotation process. Miami's mill was built for gravity concentration prior to the initiation of the flotation process; and the Inspiration mill, as originally planned, also provided for gravity concentration. The Miami mill was remodeled in order to install Callow flotation machines and Hardinge ball mills. During pilot-plant work, preliminary to the construction of the Inspiration concentrator, several types of early flotation machines, including the Minerals Separation and the Callow type, were tried out. The pneumatic-separation principle was found to be superior to the mechanical-agitation principle for this work, and a new, simplified cell was developed: the Inspiration. Four Callow cells and one Minerals Separation machine were installed, however, along with fifteen Inspiration cells.[6] Marcy ball mills were adopted for this plant, and the flotation treatment is followed by tabling of the sandy portion of the flotation tailings.

Flotation Supplants Tables

Miami at first used tables to supplement flotation, but finally abandoned their use and adopted the milling principle of making a rough concentration by means of primary flotation, with coarse grinding, followed by a classification of sands from slimes, regrinding the

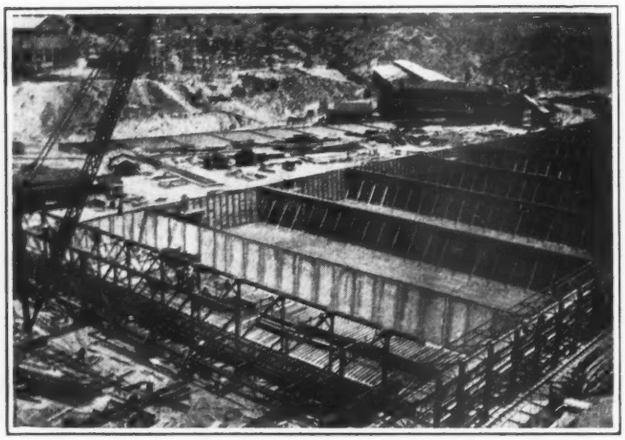
[5]David B. Scott: "Stoping Methods of the Miami Copper Company," *Trans.* A.I.M.E. Vol. 55, 1916, pp. 137-153.
Mining Engineer's Handbook, Peele, "Examples of Block-caving Practice," pp. 638-641.

[6]Rudolph Gahl: "History of the Flotation Process at Inspiration," *Trans.* A.I.M.E., Vol. 55, 1916, pp. 576-645.



Ball mill and flotation floors in the Inspiration concentrator

This concentrator contains twenty 1,000-ton units, the ore entering each unit being ground to pass a forty-eight mesh screen by two Marcy ball mills in closed circuit with each other, each mill grinding approximately twenty tons per hour.



The Inspiration leaching plant

Leaching vats in the foreground, solution tanks, full of water, in the middle background, and the electrolytic tank house in the right background. The capacity of the plant is 7,500 tons of ore per day. The plant has recently gone into operation.

sands, and a secondary flotation treatment of both original slimes and reground material. Inspiration has evidently found the principle of tabling the sandy product of the primary flotation tailings more profitable than regrinding and again subjecting to flotation. Here the mill feed is ground only to 48 mesh. Inspiration's concentrator is of 20,000 tons' capacity daily, and is running at about three-fourths capacity. Miami's concentrator is of 10,000 tons' capacity and is running at capacity. The concentrates of these two mills, as well as those of the Old Dominion, are smelted locally at the Miami plant of the International Smelting Co.

The leaching plant of the Inspiration company is to use a seven- or eight-day upward percolation leach upon a mixed ore crushed to ¼-in. size. The leaching solution will contain approximately 5 per cent sulphuric acid and approximately 1 per cent ferric sulphate. Sulphuric acid is to be furnished by the Calumet & Arizona Mining Co., which maintains a sulphuric acid plant in connection with its smelter at Douglas, Arizona. The ferric sulphate content of the leaching solution is to be produced as a byproduct of the electrolytic precipitation of the dissolved copper from the spent leach liquor. To obtain this strength of ferric sulphate, a high-current density and a relatively low ampere-efficiency is necessary, but this was found to be the cheapest way of producing ferric sulphate, upon which the success of the entire process depends. This chemical is required to dissolve the copper from its sulphide compounds. The washing schedule includes both standard types, upward percolation and downward displacement washes, there being a total of eight washes.[1]

Present Officials of Company

T. H. O'Brien is general manager of the Inspiration Consolidated Copper Co. Felix McDonald is mine superintendent, Guy H. Ruggles mill superintendent, and H. W. Aldrich superintendent of the leaching department. L. O. Howard is superintendent of the International smelter. F. W. McLennan is general manager of the Miami Copper Co. J. H. Hensley, Jr., is mine superintendent.

Wages in this district are on a level with those in other Arizona mining camps, but are lower than wages in northern states, and are unattractive to the best of skilled labor in most all departments. Muckers are paid $4.40, miners, $4.95, millmen, $4.40, Mexican labor, underground, the same as for other underground labor, and on the surface, $2.75. The supply of Mexican labor is abundant, and the workers are glad to work at the wages paid, and are not much concerned by the dangers and hardships which naturally attend this type of mining. For the wages paid, living expenses may be said to be high, and accommodations which make for the contentment of labor are none too many. Labor troubles, however, are all but unknown.

Aside from the Old Dominion, the Miami, and the Inspiration companies there are three smaller producing copper mines in the district, the Iron Cap, the Superior & Boston, and the Arizona Commercial. There are several prospects in the various stages of exploration and development, and one is of proportions that presage future importance. This is the project of the Pinto Valley company, which is at present churn-drilling an orebody of 1.5 per cent copper content, 6 miles northwest of Miami. These explorations have not yet reached a stage at which a definite amount of ore is considered to be blocked out, but one orebody of 3,000 ft. in length has been proven to exist and a second area has been found to contain ore and is being drilled also.

The general trend of future developments in this district will probably be in keeping with the trend of the times in the entire mining industry: that of the exploitation of increasingly low-grade material which is as yet too lean to be treated at a profit. Inspiration could probably leach, under proper conditions, 0.5 per cent ore at a profit, at present prices of copper.

To the originators of the Miami Copper Co. goes the credit for making the first ore discoveries and for being the pioneers in this type of copper mining in this area. The Miami company has developed a mining and ore-dressing efficiency which is unbeaten in the economical exploitation of copper ores.

[1]G. D. Van Arsdale, paper read before the 1926 meeting of the American Institute of Mining and Metallurgical Engineers, on the leaching process of the Inspiration Consolidated Copper Co.

Powdered Coal in Japanese Copper Blast Furnaces

Powdered coal has, in the last few years, been introduced as a fuel for copper-blast furnaces in Japan. For many years lump coal has been introduced into the tuyères of such furnaces, a practice essentially Japanese so far as known, but powdered coal seems to give better results, according to an article by Heinosuke Yabe in *Nihon-Kogyokwaishi*. Pulverized coal used at the Hidachi smelter is made of a poor quality lignite mixed with a higher grade coal. The apparatus used is the Holbeck system, manufactured by the Bonnot Co. Blast pressure at the burners in 2 lb. per square inch, somewhat higher than in the ordinary type of apparatus as used for reverberatory or steam furnaces. The fuel required per unit of charge is as follows:

	Per Cent Fuel Used	
	Pulverized Coal Firing	Ordinary Tuyère Coal Firing
Coal for pulverized coal.....	3.7	....
Lump coal for tuyère coal.....	0.91	3.68
Coke fed with charge.....	0.91	1.56
Total	5.52	5.24

The powdered coal used has a heating value of only 84 per cent of that of lump coal. Its use has a tendency to increase the smelting capacity of the furnace and has made a saving in the total expense of operation per unit of charge.

Leaching Zinc-Lead Ores With Gas-House Liquor

Details of the Gordon Process as Carried Out in a New 75-Ton Plant at Salida, Colorado

By A. H. Hubbell
Managing Editor

AT THE OLD SMELTER at Salida, Colo., formerly operated by the American Metal Co., the Metals Extraction Corporation has equipped a plant for the treatment of complex ores containing zinc, using the Gordon gas-house liquor process. The details of this leaching process, as given here, were obtained upon a recent visit. They are presented without comment simply to record them for the benefit of those interested. William F. Gordon is the inventor of the process. By means of it he hopes to be able to recover 85 to 95 per cent of the zinc contained in complex zinc-lead ores of a certain class, basing his expectation on a trial run recently made.

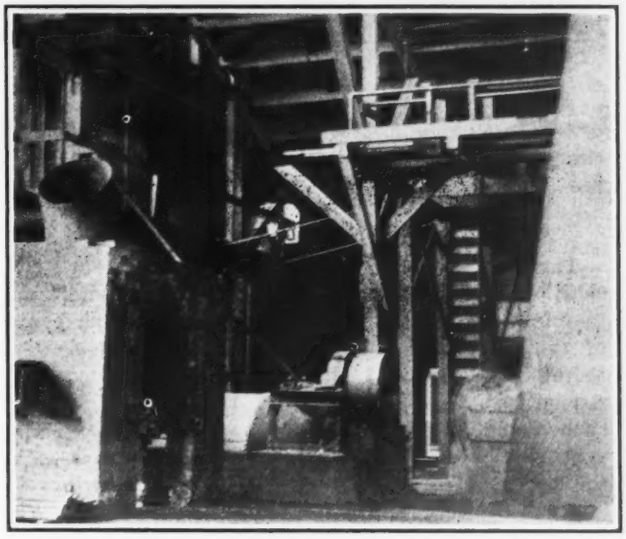
By this process the zinc is produced in the form of a granular or crystalline oxide, which is very pure. In the residue after leaching are found whatever gold, silver, lead, and iron the ore contains, together with any gangue. This residue is smelted by ordinary methods and, since the lead and iron are in oxidized form, the company anticipates that it will find ready acceptance at the smelter.

Not Ammonia Leaching

Mr. Gordon stresses the fact that his process is not one of ammonia leaching but of leaching by gas-house liquor, which is a very cheap solvent. Gas-house liquor contains many things besides ammonia. Principal among these are ammonium carbonate, which is the effective leaching agent, and ammonium sulphide, which must be removed before using the gas-house liquor as a solvent. The method of removing the sulphur of the sulphides and not affecting the other useful compounds is covered by a patent.

According to Lunge in "Coal Tar and Ammonia," ordinary gas-house liquor contains ammonium carbonates (mono-, sesqui-, and bi-); ammonium sulphide or $(NH_4)_2S$; ammonium hydrosulphide (NH_4HS); ammonium cyanide, and ammonium acetate, all of which are considered free ammonia, being volatile at ordinary temperatures; and possibly free ammonia, though Lunge sets this down as doubtful. In addition, it contains the sulphate, sulphide, thiosulphate, thiocarbonate, chloride, sulphocyanide, and ferrocyanide, all of which are fixed at ordinary temperatures. As stated above, the sulphides must be removed before using the liquor as a solvent.

As to the raw material for this process, it is considered preferable to have a sulphide ore running two-thirds zinc and one-third lead in combined zinc-lead content. Copper, gold, and silver are also desirable metals in the ore, but an ore is not desired in which those metals predominate. To get a suitable feed for the plant in its experimental work, the company erected a 100-ton mass flotation mill at Leadville. On an ore from that district running 27 to 30 per cent iron, 14 to 18 per cent zinc, 5 to 10 per cent lead, and 4 to 5 oz. silver Mr. Gordon claims to make a mass concentrate running 35 to 40 per cent zinc, 10 to 20 per cent lead, 7 to 8 oz. silver and 12 to 16 per cent iron, with 95 per cent of the zinc-lead and silver in the concentrate. The reagents used are 0.25 lb. sodium cyanide, 1 to 3 lb. lime, 0.07 lb. pine oil, and 0.2 to 0.5 lb. potassium xanthate per ton.

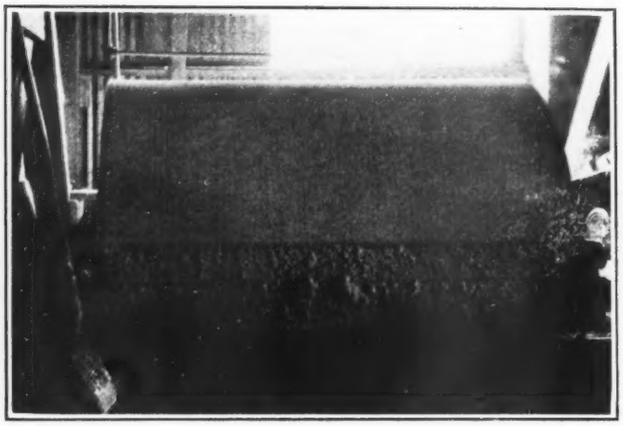


Here the roasted ore is cooled, screened, the oversize ground, and the whole elevated to the hopper from which the agitators are charged

The concentrate from the Leadville mill is treated in the leaching plant at Salida in the following manner: The first step is to roast it to break up the sulphides. This is done in a seven-hearth roasting furnace (which also has a drying hearth). An effort is made to get the roasted product into its most soluble form, which is held to be 80 per cent ZnO and 20 per cent $ZnSO_4$. The temperature must be kept between 700 deg. and 750 deg. C., or between the point where the sulphides break up and that where insoluble compounds form. Pulverized coal is used to fire the roaster. Eventually Mr. Gordon hopes to install producer-gas furnaces and use the gas for roasting and for power. With the addition of scrubbers he would also be able to produce sufficient gas-house liquor to operate his leaching plant and incidentally recover the tar in the producer gas.

The capacity of the present roaster is between thirty-five and forty tons per twenty-four hours, though the maximum has not been tested. At the present time a second roaster, similar in type and capacity, is being installed, upon the completion of which the plant will have an estimated capacity of seventy-five tons per twenty-four hour day of an ore containing 40 per cent to 45 per cent of zinc and lead combined.

From the roaster the roasted product is passed through a cylindrical cooler rotating in water, and thence to a 40-mesh vibrating screen. From this the undersize goes to a bin, the oversize being sent to a small rod mill. From the bin the 40-mesh material is



Zinc precipitate coming off the drum filter

drawn in a car and, after being elevated, is passed to a charging hopper, from which three Devereux agitators are successively charged.

Charging and Agitating

The gas-house liquor used is a 12½ per cent (NH_3) solution. Solution of this strength will handle commercially 1 lb. of zinc per gallon. The zinc content of the roasted ore being known, the charge for each agitator is calculated, the solution being added to the roasted ore in the proportion of 1 gal. of liquor for each pound of zinc in the ore. A slight excess of solvent is allowed. Six hours are required to complete the cycle in each agitator, two hours charging, two hours agitation, and two hours discharging. When the charging of the first agitator is finished, agitation begins, and at the same time charging of the second agitator is started. Thus the three agitators are always successively one step (of two hours' duration) behind each other.

After agitation the charge in an agitator is discharged into a tank thickener. The overflow from this is the pregnant solution which passes to two stills along with the later wash solutions. This pregnant solution contains the zinc in the form of $ZnCO_3(NH_4)_2CO_3H_2O$ according to the following formula:

$$\underset{\text{(Calcine)}}{ZnO} + \underset{\text{(solvent)}}{2NH_4OH} + 2CO_2 \rightarrow \underset{\text{(solution)}}{ZnCO_3(NH_4)_2CO_3H_2O}$$

this equation being according to L. K. Jacobsen, chemist for the Metals Extraction Corporation, to whom the other equations given are also to be credited.

Copper Removed, If Over 0.2 Per Cent

If this pregnant solution contains as much as two-tenths of 1 per cent of copper it is passed through a so-called copper recovery tank before going to the stills. This recovery tank is divided into compartments by baffles, the space between the baffles being filled with dross zinc, the coarsest of which is nearest the entering solution. The solution is caused to circulate through the zinc, thereby precipitating the copper and any cadmium and taking an equivalent amount of zinc into solution. This solution is practically saturated with zinc at 1.3 lb. zinc per gallon.

In any case, the pregnant solution ultimately finds its way into the two stills, where distillation is effected by passing live steam into it. As a result, the zinc is precipitated as $ZnOZnCO_3$, which is white and granular, and the NH_3, CO_2 and water vapor go to a condenser. The equation expressing the reaction that takes place is as follows:

$$\underset{\text{(solution)}}{2ZnCO_3(NH_4)_2CO_3H_2O} + \underset{\text{(steam)}}{\text{Heat}} \rightarrow \underset{\text{(precipitate)}}{ZnOZnCO_3} + 4NH_3 + 3CO_2 + 4H_2O$$

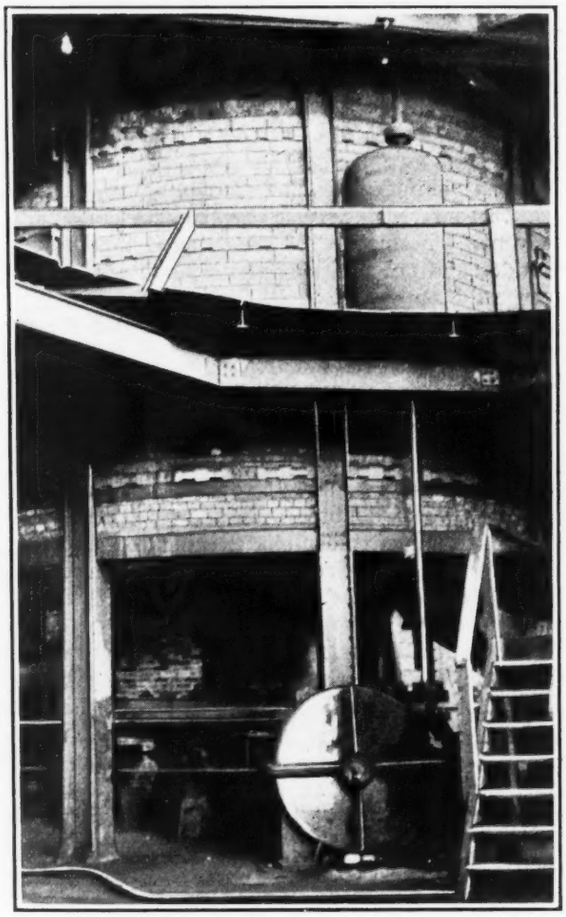
The basic carbonate precipitate and water, together with any fixed ammonia, principally the sulphate, are pumped to a tank thickener, where the precipitated zinc is allowed to settle away from the water. The overflow water containing the fixed ammonia has lime (CaO) added to it, which frees the ammonia. This is pumped to two stills other than those already mentioned, where by means of steam the ammonia is driven off and sent to the condenser. The water and lime compounds are discharged to waste.

The zinc precipitate is discharged from the bottom of the thickener, filtered in a drum filter, and the filter cake calcined, releasing CO_2, which is returned to the condenser. The calcined ZnO runs 79 plus per cent zinc and is in a granular form, thus:

$$ZnOZnCO_3 + \text{heat} \rightarrow \underset{\text{(granular)}}{2ZnO} + CO_2$$

This can be converted into the amorphous form, the zinc oxide of commerce, or into metal, in the ordinary retort used by the zinc smelters. This expressed in equation form is as follows:

$$2ZnO + C \rightarrow \underset{\text{(vapor)}}{Zn_2} + CO_2$$



Seven-hearth roasting furnace in which the ore is roasted before leaching

$$Zn + \tfrac{1}{2}O_2 \rightarrow \underset{\text{(amorphous)}}{\underset{\text{(Vapor)}}{ZnO}}$$

In the foregoing it will be noticed that all vapors are returned to the condenser and all solutions containing gas-house liquor to the charging tank. By sampling, the solution in this tank is kept at the desired strength of 12½ per cent.

The capacity of these two stills is 7,000 gal. each every eight hours, equivalent to 7,000 lb. of zinc each, in the form of $ZnOZnCO_3$ every eight hours, or 42,000 lb. of zinc for the two stills per twenty-four-hour day. As soon as the second roaster, now being installed, is ready, the plant will have this capacity, according to Mr. Gordon.

To return to the tank thickener into which the agitator tank discharges and the overflow from which constitutes the pregnant solution: The leached ore, containing the lead, gold, silver, iron, and copper, discharged from this thickener, is pumped to a second thickener, in which it receives a countercurrent wash with strong gas-house liquor. The overflow from the second thickener, containing a small per cent of zinc (about 2 per cent), is sent to the original charging tank, and the washed ore is pumped to a third thickener, in which it is again given a countercurrent wash with strong gas-house liquor. These wash solutions go to the stills.

In the washed ore which is discharged from the last thickener are to be found the lead of the original feed, now in the form of carbonate and oxide, and the iron in the form of oxide, together with whatever gold and silver there may be, as well as gangue material, such as lime, silica, and magnesia. The zinc has been removed. No trouble in disposing of this product is anticipated by the company.

Sodium Sulphate in Canada

"Sodium Sulphate of Western Canada, Its Occurrence, Uses, and Technology," is the title of a report under the authorship of L. Heber Cole, recently issued by the Mines Branch of the Department of Mines, Ottawa, Canada. Although the occurrence of saline lakes in western Canada has been known for many years, it was a search for potash during the Great War that directed serious attention to their commercial possibilities and led to their examination in detail. These lakes occur in depressions in the morainic drift of Manitoba, Saskatchewan, Alberta and British Columbia; they vary greatly in size and salinity from those in which the waters are only slightly alkaline and in which no crystal bed is present to those containing thick-bedded crystal deposits, which at certain seasons are completely dry. These deposits consist chiefly of hydrous sodium sulphate (Glauber's salt) with small percentages of magnesium sulphate, sodium chloride, and related salts. These investigations by the Mines Branch show the presence in the twenty-one deposits examined in detail of over 115,000,000 tons of hydrous salts, mainly sodium sulphate.

In Canada sodium sulphate, in the form of salt cake, finds its largest use in the pulp and paper industry and is also employed in the metallurgical, glass, dye, textile, and other industries. Upward of 40,000 tons, mostly imported, is used per annum. Until recently most of the salt cake used in commerce has been produced as a byproduct in making hydrochloric acid from salt.

A map of Western Canada accompanying the report shows the location of eighty-three occurrences of these natural deposits, and the report contains complete descriptions of twenty-one of those which were surveyed, drilled, and examined in detail by the field parties under Mr. Cole. The mineralogical, physical, and chemical characteristics of the several salts are described in separate chapters. The probable mode of origin of the deposits is also discussed. Industrial uses of sodium sulphate in the several industries and the technology of its manufacture are described. A method of examining the extent of individual deposits has been demonstrated, the character of the deposits shown, and the basis laid for the future development of extensive industries.

The report (No. 646) is a comprehensive volume of 155 pages, fully illustrated with photographs, drawings, and maps. It represents the results of several seasons' field work. Copies may be obtained by application to the Director, Mines Branch, Department of Mines, Ottawa, Canada.

Large Dredge for Russian Gold Fields Begins Long Journey

One of the largest placer dredges ever built for use in a foreign country was recently shipped to Russia. It was built by an American manufacturer for the Lena Goldfields, Ltd., of London, and has been in storage in the United States since before the World War. It is now on its way to Siberia for operation on the Lena River.

The hull of the dredge is 170 ft. long, 60 ft. in beam, and 13 ft. 6 in. in depth. The dredge will dig, by means of a digging ladder and endless chain of buckets, to a depth of 80 ft., and will deposit oversize gravel 176 ft. from the stern by means of an endless belt operating over a long pivoted conveyor. Each of the 101 digging buckets has a capacity of 17 cu.ft.

The dredge is of the completely electrified type and will be operated by induction motors with a total of 1,335 hp. Power will be generated at three hydroelectric plants owned by the Lena Goldfields, Ltd., and located on the upper reaches of the Vitim.

The complete machine, weighing about 3,000 tons, will have to complete a 13,000-mile journey before it is on the ground and ready to assemble. This journey is part by rail, part by ship, and part by tractors, horses, and wagons over a hilly country. It was shipped to Baltimore in approximately seventy-five freight cars, will cross the Atlantic, skirt the coast of Norway and land at Murmansk, Russia, just south of the Arctic Circle. Thence it will go by rail again to Irkutsk, near Lake Baikal. From that point the shipment will be transported by wagons, carts, and tractors over 200 miles of hilly country, through which no roads pass, to a point near the source of the Lena River, whence it will travel by barge 900 miles and finally 11 miles by rail again to its destination. It is expected to arrive next June.

The dredge crew will consist of twelve men, who will work on three eight-hour shifts. Operation of the boat will be in charge of a dredge master. The dredge will work during the summer months only, the remaining time being occupied in overhauling and putting the machine in condition for a resumption of dredging operations next season.

Discussion

The Origin of Veins

THE EDITOR:

Sir—Professor Lindgren, in his paper "Magmas, Dikes, and Veins," refers to the force exerted by growing crystals as a factor in the formation of veins, and states that, "recently Taber has been the most prominent champion of this view, but there are many others apparently overlooked by Taber. The originator of this theory seems to have been von Weissenbach, about 1836. Bischof, Volger, and others had similar views. In fact, the latter investigator experimented with copper sulphate and showed how fibrous veins of this material were able to break earthen vessels."[1]

The papers on this subject are so widely scattered that it is very difficult for an investigator to see all of them, but if I have overlooked any important contribution to the theory I am not yet aware of it, and certainly the evidence cited by Professor Lindgren is erroneous.

In my paper on the "Mechanics of Vein Formation" I credited von Weissenbach (1836) with being "the first to assume a force of crystallization in explaining geological phenomena."[2] I further stated that von Weissenbach in 1850 had advanced a theory in explanation of the origin of fibrous veins which was very similar to mine, though the evidence he brought forward in support of it was erroneous. In several papers I have referred to Lavalle (1853) as the first to record experimental proof of pressure exerted during crystal growth.[3] The work of von Weissenbach and of Lavalle therefore preceded that of Volger (1854) referred to by Lindgren. I have seen the article by Volger, but I found in it no description of experiments with copper sulphate and no description of fibrous veins of this material. Volger merely states that he accidentally allowed a solution of copper sulphate to evaporate in a glazed earthenware vessel. Some of the solution seeped through imperfections in the glaze and, on crystallizing, forced off flakes of the glaze. All of these papers and many others are listed in the excellent bibliography by Andre to which I have repeatedly called attention.[4]

These early papers are, however, of very little help to an investigator today, as they cite almost no evidence, either experimental or observational. My investigation was begun after the appearance of the paper by Bruhns and Meklenburg[5] describing their experiments, which were probably the most detailed made up to that date, and which led them to believe that Lavalle, Becker and Day, and others were wrong in concluding that growing crystals could exert pressure.

In a carefully planned series of papers I have presented:

1. Experimental evidence bearing on the growth of crystals under external pressure.

2. Experimental evidence on the origin of veins and vein structures.

3. Evidence on the origin of veins and vein structures obtained through a study of small barren veins in a region of unaltered sedimentary rocks, such veins often furnishing clearer evidence as to the mechanics of vein formation than the larger and more complex ore veins.

4. Evidence bearing on the origin of asbestos veins and of ore veins.

In regard to the origin of most ore veins there is little difference between Lindgren's views and mine; he places somewhat greater emphasis than I do on the filling of open fissures, and I place somewhat greater emphasis than he does on pressure due to crystal growth as a factor in vein formation. I also believe that this pressure is a factor in the formation of replacement deposits, whereas Lindgren and Boydell do not. This latter phase of the problem I have discussed in a paper on "Metasomatism and the Pressure of Growing Crystals," which will appear in an early number of *Economic Geology*.

With reference to serpentine asbestos or chrysotile veins, Lindgren things it unlikely that they are "fillings of contraction cracks," and suggests that "other authors are probably correct in considering them the result of a recrystallization of the serpentine, proceeding inward from the cracks."[6] Evidence has convinced me that cross-fiber veins have been formed by a process of lateral secretion; that their structural peculiarities are largely due to the mechanical limitation of crystal growth through the addition of new material in only one direction, the material being supplied through small closely spaced openings in the walls; and that the immediate walls have been displaced by the growing veins, replacement being of very little importance.

This theory of vein formation satisfactorily accounts for the following facts:

1. Cross-fiber veins of gypsum, anhydrite, calcite, talc, crocidolite, celestite, nemalite, chrysotile, chalcanthite, alum, and other minerals all show the same structural peculiarities.

2. Cross-fiber veins are found in many different kinds of fine-grained rock.

3. They are always composed of essentially a single mineral which is either a constituent of the wall rock or may be derived from minerals that are. The chemical composition of the veins may be quite different, however, from the inclosing rock.

4. The walls are sharply defined, and concavities in one wall match opposite convexities.

5. Many minerals rarely show a fibrous habit, except where they occur in cross-fiber veins.

6. The fibers are normal to the walls in some instances and oblique in others, but in a single vein they are parallel and their length does not appreciably vary because of irregularities in the strike of the walls.

7. In some veins the fibers extend from wall to wall

[1] A.I.M.E., Pamphlet No. 1575—I, p. 13, June, 1926; also *E. & M. J.*, Vol. 122, No. 4, p. 130, 1926.

[2] Bull. A.I.M.E., No. 140, p. 1199, 1918.

[3] *Am. Jour. Sci.*, Vol. 41, p. 532, 1916.

[4] *Op. cit.*, p. 532.

[5] Sixth Jahresbericht d. Niedersächsischen geologischen Vereins, pp. 92-115, 1913.

[6] "Mineral Deposits," p. 398, 1919.

without a break; in others there are one or more partings.

8. Angular fragments of the wall rock frequently mark the partings and they are also unevenly distributed through the veins.

9. The fibers may be straight, gently curved, or sharply bent, but adjacent fibers are always parallel.

10. In some veins color-bands, partings, and similar features show irregularities that are parallel to irregularities in the adjacent wall.

11. In some veins color-bands, partings, and similar features are faulted parallel to the fibers without the faults extending into the walls.

Nearly all of the structural features listed above have been duplicated in veins grown in the laboratory. If Professor Lindgren will explain how these structural peculiarities can develop in veins formed by recrystallization or by replacement, he will place the theory on a firm foundation; until this is done by some one the theory is, to put it mildly, highly speculative.

The problems of vein formation must be solved, as all scientific problems are ultimately solved, by the evidence and not by the voice of authority. STEPHEN TABER.

University of South Carolina,
Columbia, S. C.

Three Iron Country Accidents

THE EDITOR:

Sir—Your editorial, "Three Iron Country Accidents," in the Nov. 13 issue of *E. & M. J.*, comments on the Barnes-Hecker disaster in a manner that I think gives a wrong impression. You reason that "there was no chance breaking in of surface waters"—as at Milford—because the highest workings were 450 ft. from surface.

Evidently the men had blasted and gone to lunch; the rush of sand and water engulfed them. Now, nobody knows whether they had just blasted a slice. That is unimportant; that wouldn't have brought the mine down. The mine originally was wet, 2,000 gal. a minute. But water had gradually diminished until there were only about 700 gal., and the ore had become good for slushers. Some of the drill holes from surface had gone dry and others had reduced their flow. There was no acceleration of the underground flow to give warning of impending trouble. These holes had been drilled on 200-ft. co-ordinates, at lesser intervals over ore, and the rock (jasper) surface contour seemed fairly even. Over the workings there was a 250-ft. back of rock, of which the lower 50 ft. was ore.

These men were not a floating mine population—greenhorns; they were experienced underground miners, residents of the location, accustomed to that ground. If the timbers had taken weight in the customary manner they would have known it in ample time. They were working for a company that excelled in mine precautions and whose efforts to safeguard its men were unsurpassed; a company which went to greater lengths than most to impress on its employees the need for care, and to enforce its safety regulations, and which for years has employed careful supervision.

You feel that this was a collapse of the roof through inadequate support; but the openings were plugged with timber. The upper two slices were cribbed solid. Superintendent Elliott states that ordinary slicing methods were employed, that after a room had been mined and before it was blasted down, it was thoroughly timbered, "lagged and cross lagged," and there must have been a crushed mat of timber 50 ft. thick above the men who were killed. The timber was watched; it seemed that the back was caving splendidly; it seemed to take weight right. It is possible that there might have been a seam or a slip against the slate footwall that hung, and did not come down, so that when it did give on this fateful noon, it had force enough to go right on through to the 600. It might have been that a channel came into being between the caved hanging and the solid hanging which chimneyed up to the sand and let the wet material down under great pressure.

You say that "it is rarely that such occurrences take place without giving some warning." True; but really it seems quite plain to us here that this was one of those rare occurrences. The type of men and the character of supervision seem to preclude any other opinion.

This was not a case like that at Consolidated Vermillion some eight years ago, where several men were entombed when a drift ran into an unexpected swamp; nor like Milford, where a pond apparently 300 ft. away reached under a solid surface right to the mine boundary. Each of these cases must be judged on its own evidence and with as full a knowledge as possible of contributing conditions. Probably, unlike these two others, it will never be possible to determine the precise cause of this disaster. DWIGHT E. WOODBRIDGE.

Duluth, Minn.

Why He Discontinued

THE EDITOR:

Sir—I notified your "subscription collector" *not* to renew my subscription to your paper for the following reasons:

1. Editorial policy is opposed to all classes of *mining promoters* except the entrenched "Jewish Houses," U.S.S.R., A.M.I., etc., etc.

2. The paper is too dry and full of "technical drivel."

3. The editors *are dead* but they don't lay down.

4. Mining is not such a gamble as they seem to think it is. I personally have made money "mining."

606-315 Montgomery St. W. T. DINNEEN.
San Francisco, Calif.

The Prospector

THE EDITOR:

Sir—I liked your recent tribute to the prospector, containing your statement that an occasional letter from one of them was the most interesting correspondence that ever came to the editor's desk. You are right that the old breed is not quite all dead yet. There are a number of them in Mexico, most of them broke; some that have made "finds" in recent years and are saying little about it, and consider it inadvisable to denounce the ground until in a position financially to go ahead with it. This gives an opportunity for those that play mining from the other end to get in on a few good things on advantageous terms. The prospectors are past the point of asking a square deal; about all they are asking is that after the deal is over there is a little something left to them.

The bunch that believe in beating the discoverer out of everything he has will please not apply.

Mexico City, Mexico. PAUL R. COOK.

Consultation

Coefficient of Friction of Bearing Metal

"In your issue of Nov. 6th there is an article on ball, roller, and plain bearings, in which the author gives the coefficient of friction (average practice) for plain bearings as 0.02. Can you tell me whether this refers to lead-based or tin-based bearings? Can you tell me the coefficient of friction (average practice) of lead-based babbitt, such as 80 lead, 15 antimony, 5 tin; and of tin-based babbitt, such as 89 tin, 4 copper, 7 antimony? If you can tell me what authorities to look up in order to get this information I shall appreciate it."

Most authorities on bearing friction do not make any distinction between lead-based babbitt or tin-based babbitt or any other bearing metal.

Inasmuch as bearings are invariably lubricated or should be lubricated, and since the lubricant used is of principal importance, it makes little difference so far as friction is concerned whether the bearing has a lead or tin base.

If a bearing is properly lubricated there is no metallic contact; hence it is obvious that the friction depends mostly upon the lubricant between the metals.

When the oil film breaks there is metallic contact, and that is why a smooth low-friction metal is desirable. But the oil film should not break. If there is metallic contact, conditions are abnormal.

Of course there is some friction between the lubricant and the metal as well as the internal friction in the lubricant itself, and it is quite possible that the composition of the metal has something to do with the friction between the metal and the lubricant. However, it is not apparent that this fine difference has ever been measured.

L. P. Alford is the author of a book entitled "Bearings," which is published by the McGraw-Hill Book Co., 370 Seventh Avenue, New York City.

Two Questions on Tin

"I desire to secure some information on Bolivian tin ores and the ease and comparative cost with which they can be refined in comparison with those of other sources, such as Straits. We would also be glad to have any information on the suitability of the Bolivian tin for solder purposes."

In general, Bolivian tin concentrates are much more impure than those obtained in the Straits, as they contain more arsenic and sulphur and also larger proportions of various heavy metals. This makes the cost of smelting and refining these ores higher than in the case of those from the Far East, and also results in a lower-grade product. We do not think that detailed costs have been published, but you can get a good idea of the situation by referring to the chapter on Tin in "Handbook of Non-Ferrous Metallurgy," by D. M. Liddell, recently published by the McGraw-Hill Book Co.

Unless complicated refining methods are employed, the tin from Bolivian concentrates is what is known as "99 per cent grade," so a high-grade tin can be made at greater cost.

The 99 per cent grade tin is the kind ordinarily used for making solder, as the impurities that are present are not deleterious for this purpose. It occasionally happens, however, that in making certain high-grade solders for special purposes, this grade of tin is undesirable.

Not a great deal of detailed information has been published on the subject, but in addition to the references above given you might consult a book entitled "Tin Fields of the World," by W. R. Jones, published at 30 shillings, by Mining Publications, Ltd., London Wall, London, E. C. 2, England.

"What in general is the process of smelting tin ores?"

Tin smelting does not differ materially from the smelting of the ores of other metals, except that the reduction is simpler, and, because of the absence of appreciable quantities of sulphur, matte is not formed. The smelting of tin would appear to be a fairly simple process, and, as far as the actual smelting operation is concerned, the process is not complicated according to R. L. Hallett, of the National Lead Co. The great difficulty in tin smelting is introduced by the fact that tin oxide combines readily with silica to form silicates of tin, and during the smelting of tin concentrates mixed with flux and fuel a considerable amount of tin invariably combines with silica and goes into the slag in the form of readily fusible silicates of tin mixed with the other more or less complex silicates which make up the slag. On the other hand, if an extremely basic slag should be used, tin will act as an acid, and again enter the slag.

In smelting ores of lead and copper, it is comparatively easy, with the production of metal, matte, and slag in the case of lead smelting, or with matte and slag in the case of copper smelting, to hold practically all of the lead and copper in the metal or matte, as the case may be, and prevent it from going into the slag. In tin smelting, however, while a large proportion of the tin is reduced and recovered in the form of metal, an unduly large amount invariably fluxes with silica and goes into the slag. The amount of tin contained in practically all slags from the primary smelting of tin concentrates is so extremely high that such slags cannot be discarded but must be re-treated for their tin contents. As it is necessary to resmelt the first-run slags, it is important to use only a small amount of fluxing material in smelting of tin concentrates so as to produce a minimum amount of slag.

The smelting of tin, therefore, embraces three distinct stages: the primary smelting of tin concentrates in a blast furnace or in a reverberatory furnace with the proper addition of fluxes and fuel; the re-treatment of the first-run slags to recover the tin which they contain, and, finally, the refining of the reduced metallic tin to remove the metal impurities which are reduced with the tin in the smelting process. This may be accomplished either by fire methods or by electrolysis.

News of the Week

Summary

LAKE IRON-ORE SHIPMENTS largest in history, approaching 60,000,000 tons—Development under way at Ford's Blueberry mine—Oliver installs new equipment at Section 16 mine.

Gaspe Peninsula, Quebec, contains promising ore deposits—Hollinger milling 5,500 tons daily—Nova Scotia to enforce forfeiture clause relating to unworked mineral claims.

Mexican Congress discusses relief for mining industry on basis of silver prices—New automobile road between Mazatlan and Durango.

Outlook for Wiluna gold mines hopeful—Senators visit Rand mines.

Moctezuma Copper Co. stages safety-first celebration.

Three new mills completed in Joplin-Miami district—Callahan Zinc-Lead on production basis—Lincoln mine plans extensive development.

Moore mine levies assessment to continue development—Barnes-Hecker reclamation progresses slowly in face of serious danger.

Quincy installs new boilers and electric pumps—Keweenaw Copper calls special meeting of stockholders for Dec. 15.

Beaver Consolidated and Kirkland Lake in litigation—New Cornelia has large reserves of carbonate ore.

Only one platinum producer in South Africa—Sicilian sulphur mines being electrified.

Recent Ore Discoveries in Ontario

Copper Deposits Near Timmins—Coniaurum Picks Up Vein on 1,250 Level—McIntyre Has $14 Ore at 1,875 Ft.

By Our Special Correspondent for Northern Ontario

WORD has been received of a copper-gold discovery in the townships of Jamieson and Robb, about 18 miles northwest of Timmins, Ont., which appears to be of considerable importance. The Porcupine district is all excitement, and a regular old-fashioned rush has developed. All the larger mining companies have sent parties in, and practically every vehicle which can move over the road is being utilized for transportation purposes. Already about 400 claims have been staked, and the indications are that between 600 and 700 claims will be staked before this issue of *Engineering and Mining Journal* is distributed.

The discovery was made by George Jamieson, who was grubstaked by a local syndicate. Samples taken over a width of 150 ft. give 3½ per cent copper. Though it is doubtful if this average will be maintained over such a width, the opinion of well-informed engineers in Porcupine is that the discovery is important, and it is understood that substantial offers have already been made for the property. The deposit has been traced for a length of 1,000 ft. and for a width of 150 ft., but, aside from this, the preliminary assays, and the generally favorable impression, little is as yet known.

The townships of Jamieson and Robb have been the scene of gold staking at various times extending over the last fifteen years, but although many claims have been staked, the possibilities for gold have not been considered very promising. It was during the investigation of some gold showings that the present discovery was made. The country is covered with overburden and rock exposures are few.

A new discovery has been made on the Coniaurum Mines property at Porcupine, Ont., which is believed to be of considerable importance. The vein was picked up on a crosscut at the 1,250 level and shows 8 ft. of $8 to $9 ore. Developments on this property at both the 1,250 and 1,500 levels have been of considerable importance, and if favorable results keep up it is expected that next year the company will make arrangements for a 500-ton mill.

A new discovery has also been made on the McIntyre, where a 10-ft. width of $14 ore was found on the Pleneurum claims, at the 1,875 level. This is east of the No. 11 shaft and lies in the territory which that shaft is expected to develop. Eight years ago diamond drilling intersected some good ore sections a little below the 1,000 level, but a heavy water-course was also found, which prevented its development. It was at first thought that the water-course had a direct connection with Pearl Lake, but it is now believed that this is not the case and that pumps from the new shaft will be sufficient to keep the water under control.

New hoisting engines are being installed at the No. 11 shaft and steady progress is being made with sinking operations.

At the Canadian Lorrain property a discovery has been made during the last few days, on the 150 level of the No. 10 vein, where high-grade ore over a width of 10 in. was encountered. Slow deliveries of material have held up the starting of the mill, but it should be ready to begin operations about the end of the month.

The October report of the Keeley mine, of South Lorrain, shows a production of 124,853 oz. of silver and 14,233 lb. of cobalt. At the end of October the new oreshoot at No. 16 vein had been developed for a distance of 35 ft., with the face still in ore, and gave an average of 50 oz. of silver over a width of 42 in. Developments on the new sublevel, which are the lowest workings of the property, are important, but the work has not yet been sufficiently advanced to permit a definite opinion as to the possibilities.

The Northland Gold Co., of Kirkland, has been refinanced and has started sinking the shaft from the 500 to the 1,000 level. It is understood that results on the 500 level were encouraging and that although no orebodies of substantial size were found, the improvement, as compared with surface conditions, was such as to warrant the company in going to greater depth. The Northland company has also taken an option on the Pawnee-Kirkland. A steam plant will be installed and the shaft will be sunk to 500 ft. About a year ago the property was under option to the Lucky Tiger Co., which did a considerable amount of diamond drilling.

The construction of the Rouyn Railway has been up to schedule, and as a consequence the Noranda company is now receiving consignments of structural steel and brick for the new smelter. Several carloads of steel and nine carloads of brick have already arrived at the property, and from now on there should be no let-up in deliveries. Between now and the end of the year a total of 300 carloads of material are expected.

During October the Vipond mill treated 8,315 tons and recovered $63,500, or an average of $7.65 a ton. This is an increase of $2,000 in total value and an increase of 40c. in the grade, as compared with the previous month. The month's production was the highest ever obtained at the property.

Callahan Zinc-Lead on Production Basis

The Callahan Zinc-Lead Co., Wallace, Idaho, is again productive. After suspending operations at the Callahan mine two or three years ago, the company turned its attention to the development of the Galena property. This resulted in the development of sufficient ore to warrant construction of a mill of 150 tons' capacity, which is now running full time. This will return considerable profit, in addition to providing funds to continue an extensive development program which is expected to result in greatly increasing the ore reserves and to an extent that will justify a mi l of much larger capacity. In the meantime the Callahan company will soon remodel the old Callahan mill, making it flotation exclusively, in preparation for resumption of production at the original Callahan mine.

Galena Mill, Callahan Zinc-Lead Co., Wallace, Idaho

The company made a wonderful record of production and profits in war days, when the price of zinc, which is the chief product, was soaring, but following that period the decline in the price of zinc reduced the margin of profit to an extent that caused suspension. A large tonnage in the mine above the 600 level awaits development, as well as much ground remaining to be explored, with outlook good for much new ore. Thorough tests indicate that this ore can now be profitably mined and treated by flotation, which will be done as soon as the old mill is renovated. In the meantime Callahan will drive a 4 600-ft. crosscut to the Sunset orebody of the Long Wait property.

Lincoln Mine Plans Extensive Development

Through an agreement entered into between a group of large stockholders in the Lincoln Mining Co., Wallace, Idaho, and James Hamilton, of Detroit, the latter will obtain control of the company, and plans contemplate a development program that will place the Lincoln on a productive basis. Mr. Hamilton now controls over 400,000 shares of the stock, and under the terms of the agreement he will acquire about 250,000 shares additional. All stock held by the stockholders entering into the agreement, approximately 500,000 shares, will be held by a bank in escrow, and all stockholders who desire to do so may enter the pool. With this accomplished the directors propose to levy three assessments of 1c. each to provide funds for development. Mr. Hamilton agrees to pay these three assessments on all the stock pooled, and when that has been done he will receive half of the stock in the pool and thus have a majority of all outstanding stock. The company is capitalized for 1,500,000 shares, of which about 1,200,000 shares are issued. Stockholders who do not enter the pool will of course have to pay the assessments.

The Lincoln mine is near Osburn in what is popularly called "the dry ore belt." It is developed by a crosscut tunnel almost a mile long. The vein has been explored by drifts, raises, and a shaft from the tunnel level 450 ft. deep. This has resulted in disclosing considerable lead-silver and gray copper ore, but not sufficient to supply the 75-ton mill which was constructed several years ago. It is understood that the shaft will be sunk an additional 500 ft.

Tamarack & Custer "Follows the Ore"

After a large expenditure in carrying out extensive exploratory work on No. 7 tunnel level, which failed to find the Tamarack oreshoot, the Tamarack & Custer Consolidated Mining Co., Wallace, Idaho, adopted the plan of "following the ore," and results so far indicate that it will be successful, although the opinion was long ago advanced that the ore would not persist at this additional depth.

No. 7 tunnel is what was originally known as the Mammoth No. 6, the portal of which is on Canyon Creek, on the opposite side of the divide from the Tamarack workings. It is 800 ft. vertically below No. 4, with which it is connected by a raise.

Barnes-Hecker Reclamation Progresses Slowly

The work of reclaiming the Barnes-Hecker mine, of the Cleveland-Cliffs Iron Co., Ishpeming, Mich., is proceeding slowly. Forty-one bodies remain in the workings, and months will be required before some of these can be taken to surface.

The shaft has been free of water to the first level, at a depth of 600 ft., for several days, but at this point a real mining problem confronts the engineers. The bailers cannot operate because of sand, boulders and timber wreckage in the shaft. A small pump has been in use, and this is just about taking care of the surface waters that enter the shaft from the ledge. One of the foremost hydraulic engineers of the country was in consultation with engineers of the Cleveland-Cliffs, but he did not have a solution for the sand problem. Representatives of the Foundation Co., the A. Guthrie Co., and Winston-Dear have visited the mine with the aim of offering practical suggestions. There is a serious element of danger in opening up the workings, and the management does not want to risk a single life in the reclamation work.

Oliver Installs New Equipment at Section 16 Mine

The Oliver Iron Mining Co.'s Section 16 mine, at Ishpeming, Mich., was closed Nov. 20 for a period of from four to six weeks to make machinery replacements. A new 3,000-ft. Ingersoll-Rand compressor, to be driven by a General Electric motor, has been received and is being installed. This will replace a compressor in service at the mine for thirty-five years. A new eight-inch air column is being placed in the shaft from surface to the 1,250 level. This is being assembled in 60-ft. sections on surface and lowered into the shaft and fastened with clamps, which plan has proved far more satisfactory than lowering the 20-ft. lengths.

Antimony Refinery for Trail, B. C.

Plans have been completed for the erection of an antimony refinery at Trail, B. C., and it is expected that construction work will start soon, according to a report to the U. S. Department of Commerce.

Zinc-Lead Reported Near Searchmont, Ontario

Considerable attention is being directed to the recent discovery of zinc-lead deposits eight miles northwest of Searchmont, Ontario, by Fred Vacheresse, of Sault Ste. Marie. Vacheresse staked his first claim last May, recorded it in June, and has since staked forty claims. He had found traces of galena while panning in a small creek, and though the general formation of the country would give little promise to the average man, he had confidence in his belief that the metal was there in quantity, and at last succeeded in locating the vein in the bed of a small creek. The fissure vein averages 6 ft. wide over a distance of 1,680 ft.

News From Washington

By PAUL WOOTON
Special Correspondent

"Story of Copper" Nears Completion—Barytes Freight Rates Unchanged—Other Rates Considered by Commission

SCENES depicting operations in the refining of copper are being filmed at Baltimore for the Bureau of Mines' picture "The Story of Copper." The other sections of the picture devoted to prospecting and production cover 11,000 ft. of film. This is to be cut to 4,000 ft. The entire 11,000 ft. was shown recently to representatives of the industry who are being consulted as to what may be eliminated. The picture will be ready for distribution in January. A large number of applications for copies already have been received. The first showings, however, will be made in various producing districts, where the picture is being awaited anxiously by those who participated in its making.

It is estimated that twenty copies will be necessary to meet the demand for this picture.

Producers of barytes at Cartersville, Ga., were not sustained by the Interstate Commerce Commission in their attack on the reasonableness of the freight rates on their product to eastern destinations. A representative of the New Jersey Zinc Co. and of the Bertha Mineral Co. appeared in opposition to the contention that the existing rates are prejudicial as compared with the rates from Sweetwater, Tenn. In its opinion the commission says in part:

"Deposits of barytes are found in only a few sections of the country. The principal deposits are in Tennessee, North Carolina, and South Carolina. The largest deposits in Tennessee are at Sweetwater, and are more extensive than those at Cartersville. Unlike the Cartersville barytes, the east Tennessee product is found in pocket formation scattered over a wide territory. The ore is mined by steam shovels and transported approximately 0.75 mile either by tramcars or drays to the washer, where it is washed and jigged and loaded by hand in wagons or trucks. It is then transported from 4 to 8 miles to Sweetwater at a cost varying from 82.5 cents to $1.75 per ton and is loaded by hand from trucks to the cars. The mines of complainants at Cartersville are adjacent to railroad tracks, and this ore is loaded from the washers directly into the cars.

"In 1922, on representation from barytes shippers in the South that they were experiencing difficulty in meeting import competition at eastern cities, the southern carriers published lower rates from southern points to eastern destinations. In publishing these rates the relationship of Cartersville over Sweetwater was not observed."

Rates on pig lead, red lead, and litharge, in carloads, from Joplin to Oklahoma City, are not prejudicial as compared with rates to Kansas City, in the opinion of J. P. McGrath, Interstate Commerce Commission examiner. The materials mentioned are used in Oklahoma City in the manufacture of electric storage batteries.

The American Potash & Chemical Corporation, of Trona, Calif., has filed a complaint alleging that the rates on muriate of potash from Trona to Central Freight Association territory are unreasonable and otherwise unlawful.

Rates on scrap brass and scrap copper, in carloads, shipped prior to Aug. 15, 1925, from certain points in New York and New Jersey to East Liberty and Pittsburgh, Pa., are unreasonable with certain exceptions, in the opinion of Mr. McGrath. Consideration of rates charged on like traffic from and to the same points since Aug. 15, 1925, and of rates for the future has been deferred. The complainant in this case is the Union Smelting & Refining Co.

Failure and refusal of carriers to establish a smelting in transit arrangement at East Helena, Mont., on lead ore and concentrates from Kellogg and Bradley, Idaho, to eastern destinations, does not result in undue prejudice or unjust discrimination in the opinion of W. A. Hill, Interstate Commerce Commission examiner.

His recommendation was made in connection with a case filed by the Bunker Hill & Sullivan Mining & Concentrating Co.

Shortage of Miners Reported in Colorado

A shortage of skilled and unskilled metal miners was announced by the Denver district of the United States employment service of the Department of Labor, for the month of October and the first ten days of November. This condition was reported to have existed throughout the mountain states district.

Mountain Meadow Making Regular Shipments

Continued activity in the La Platas, 15 miles northwest of Durango, Colo., has made the year 1926 one of the best years for the Mountain Meadow Mining Co., Durago, Colo. Shipments at present are being sent to the smelter regularly. The Mountain Meadow company will hold its stockholders' annual meeting Dec. 20, at which time officers and directors for the ensuing year will be elected and plans for expansion will be considered.

Drainage Project for Leadville

The Penrose Mines, Inc., Leadville, Colo., has undertaken the draining of over 400 acres of mineral land on the outskirts of the town of Leadville. The unwatering is to be done largely in a number of old shafts which were formerly worked, but which are now abandoned. In the area secured by the company there is quite a little unexplored ground, which will be thoroughly charted. The work will cost about $750,000 and is being financed to a great extent by the people of Leadville, realizing the great value the project will have in developing and renewing Leadville mining activities. Electric pumps are being installed and work of the actual drainage of the shafts will begin about Jan. 1, 1927.

Alaska Juneau in October

Alaska Juneau mined and trammed to the mill 369,900 tons in October, 1926, making a new record in respect to tonnage. Recoveries were $187,000, of 50.55c. per ton; operating expenses, $162,000, or 43.80c. per ton; operating profit, $25,000, or 6.75c. per ton. Other expenditures and accrued charges, totaling $48,250, made a deficit of $23,250 for the month.

Only One Platinum Producer in South Africa So Far

Considerable interest attached to the recent announcement that the Onverwacht Platinum Co. had, after six months' independent working, declared a dividend of 10 per cent, says the *Metal Bulletin*, of London. Protagonists of the belief that South Africa will furnish a large quantity of platinum in the future have been considerably heartened by this announcement, but it should not be lost sight of that right from the beginning the Onverwacht concern has been known to be one of the most promising, and up to the present is the only one of the many companies interested in platinum properties that has done anything on a commercial scale. This concern has just started up additional milling machinery, the plant now being able to handle 100 tons of ore a day.

During October the reduction plant milled 1,423 tons of ore, producing concentrates estimated to yield 618 oz. of platinum, the recovery rate being 8.7 dwt. per ton, compared with a yield of 8.2 dwt. from 1,370 tons of ore in September. Crosscutting on the 350 level continued, the average of the ore being 4 dwt. A prospecting shaft to 400 ft. has been started.

However, unless other South African properties are developed on a commercial scale, the output from the Onverwacht concern, even with the enlarged plant working, is not likely to affect the world's market to an appreciable extent. Considerable optimism is still voiced regarding the Rustenburg and Potgietersrust properties, but the acid test of commercial working has not yet been applied.

Sulphur Mines to Be Electrified

The sulphur mines on the Island of Sicily are to be electrified. The plan is to build a large steam power plant at Catania and to deliver the current thence by way of 310 miles of transmission line to the principal mining centers.

Development Work Under Way at Ford's Blueberry Mine

About 150 men are employed on construction work at the Ford Motor Co.'s new Blueberry mine, eight miles west of Ishpeming, Mich. The shaft has been sunk into the ledge, which is 24 ft. from surface at this point, and this part is to be concreted. The opening is 20 by 15 ft. 10 in., outside the timbers. One crew is employed five days per week, but three shifts will be worked as soon as sinking is resumed.

A new feature of the surface equipment is that everything will be under one roof in a large "U"-shaped structure. The wings of this building are 220 ft. by 40 ft. and the back portion is 215 ft. by 40 ft. This will house the office, laboratory, warehouse, heating plant, change room, engine room, and the shops. Power for the new mine will be furnished by the Cliffs Power Co., and a line has been extended to the property from the Barnes-Hecker station.

Diamond Creek Project Controlled by Arizona Corporations

In the course of investigations of asserted over-expenditures in the recent Arizona political campaign, made at the request of Senator Ralph Cameron, information concerning the Diamond Creek project, on the Colorado River, was produced. James Girand, engineer and promotor of the project, who first brought it to the attention of the late Colonel John C. Greenway, testified that he no longer had any connection with the enterprise, which has been assumed to have been financed by Calumet & Arizona mining interests. A company, known as the Colorado River Engineering & Development Co., now controls the former Girand interests in the project.

Arthur W. Engelder, an engineer connected with the Calumet & Arizona Mining Co., is secretary of the Development company, and Dr. L. D. Ricketts is president. It was indicated that a number of Arizona mining corporations own stock in the company, including the United Verde Extension and Phelps Dodge, which latter is reported to be the heaviest stockholder. The capitalization of the company is $250,000. The secretary stated it is proposed to develop about 200,000 horsepower to be transmitted electrically to Arizona mining camps. The project is in abeyance at present, pending receipt of permission from the Federal Power Commission for construction work.

Beaver Consolidated in Litigation

The action of the old board of directors of the Beaver Consolidated Mines of Cobalt, Ont., in declaring a stock dividend immediately before the election of a new board, has resulted in litigation. William Crossan James has obtained a writ against the company for the delivery of fully paid non-assessable shares of common stock of Kirkland Lake Gold Mines, being the plaintiff's dividend declared by resolution of defendant company on Oct. 13, 1926, and for damages. D. B. Hanna, president of the company, contended that the declaration of a dividend was illegal, as before the election Frank L. Culver, then president, and his associates had in their possession proxies representing 62 per cent of the outstanding shares, all of which had been given with the understanding that no distribution of the company's assets should be made until such times as an examination had been made into the position of the company. When the examination of the company's books which is now being prosecuted has been completed, it will then be within the province of the new board to consider what action, if any, shall be taken in regard to the dividend question.

Nova Scotia Claims Not Worked Will Be Forfeited

The Natural Resources Department of the Province of Nova Scotia has ruled that mineral claims in that province must either be worked or forfeited. The ruling reads as follows: "The Nova Scotia Government has decided that holders of mineral areas in Nova Scotia must work their holdings or have them forfeited in the event of application being made under and in compliance with the provisions of the Mines Act."

New Cornelia Has Three-Year Supply of Carbonate Ore

According to recent official reports, the New Cornelia Copper Co., Ajo, Ariz., still has a large quantity of carbonate ores in its mines. In the original prospecting 19 of the drill holes bottomed in ore, and recent test work has shown that the ores in a portion of the area go 300 ft. deeper than the original estimates.

Present reserves are figured as being sufficient to keep the leaching plant busy for the next three years, and it is confidently expected that additional tonnages of this ore will be found from time to time, as much drilling remains to be done.

Cresson Adds New Equipment

The Cresson mine of the Golden Cycle Mining Co., of Colorado Springs, is in a position to make a much better production and yet keep up with its development program as a result of recent improvements. The main shaft has been retimbered from surface to 500 ft. Two new pumps are being installed at the nineteenth level and will be in operation by the first of the month. The nineteenth level has not been fully developed.

Diamond Drilling Started at Stratton Estate

Drilling of the first of three diamond-drill holes to test out the geological formation of the Ironclad and Globe Hill properties of the Stratton Estate, Colorado Springs, Colo., at Cripple Creek was started Nov. 1. The first hole will be drilled to a depth of at least 2,000 ft. The drilling contract was let to the Sullivan Machinery Co. of Chicago, at the contract price of around $15,000 per hole.

Hollinger, Milling 5,500 Tons Daily, Plans Increase

The Hollinger Consolidated, Timmins, Ont., operating in the Porcupine area, is making steady progress with its program of expansion. The plant is now handling an average of 5,500 tons daily. Preparations have been made for the installation of three more rod mills. These will give the plant a capacity of about 8,500 tons daily. One of these has already arrived on the property and the other two will soon be delivered. The mine itself is equipped to supply the requisite tonnage, the central shaft being equipped to hoist ore at the rate of 12,000 tons daily.

At 3,000 ft. in depth, to which the work has so far been carried, there is no evidence of change in structure or mineralization, with the exception that there is greater dissemination of values at the lower levels. Average grade of ore may decrease, but the outlook is that the tonnage will increase. Costs have been reduced to about $4 per ton, and further substantial reductions are anticipated.

Back filling is being arranged for on an extensive scale. This has become necessary owing to the magnitude of underground operations and the large cavities left by the withdrawal of ore from the stopes. Towers have now been constructed and loading and unloading stations are now in course of erection for an aërial tramway over which an endless chain of buckets will draw sand and other back-filling material from a property 3½ miles from the Hollinger. The sand will be dumped from the tramway to the unused stopes through a system of raises, extending from surface to a depth of 1,800 ft.

Colorado Lead-Zinc Flotation Mill May Be Enlarged

The Colorado Lead-Zinc Co.'s flotation mill at Leadville, Colo., is treating 200 tons of crude ore daily. Zinc concentrates are being shipped to Oklahoma and to Belgium. The owners are considering enlarging the mill to a 500-ton capacity, as that daily tonnage can be easily secured.

Manitoba & Ontario Mines, Ltd., Incorporated

Manitoba & Ontario Mines, Ltd., with a capital of 3,000,000 shares of no par value, is being incorporated for the purpose of developing two groups of properties in central Manitoba. The organization owning these claims, which comprise 800 acres, was formerly known as the Red and Long Lake Syndicate. One group of claims comprising 500 acres lies adjacent to the Central Manitoba mines and the other, comprising 300 acres, is located near the Cryderman mine. Preliminary work has been carried on for some time, and favorable showings have been revealed. Some of the shares to be issued will go to compensate original owners and a public offering will be made of shares remaining in the treasury. Senator Robertson, of Ottawa, Ontario, is president.

Quincy Installs New Boilers and Electric Pumps

To bring about a further reduction in costs, the Quincy Mining Co., Hancock, Mich., is installing four Babcock-Wilcox water-tube boilers, with superheat and automatic stoker features, at No. 6 shaft. They will replace boiler plants at Nos. 6 and 2 shafts. No. 2 hoist, however, will continue to be operated by its own boiler plant, which is modern and efficient. The new boilers will develop from 650 to 1,000 hp.

The two Blake horizontal duplex electric pumps in No. 6 shaft, each having a capacity of 300 gal. per minute, have been in commission for six weeks. They are working smoothly and giving efficient service. These pumps will handle all the water in the mine, making bailing unnecessary. This will bring about a reduction in costs and an increase in production, as the time formerly spent in bailing can now be devoted to the hoisting of rock. This is the first time in the history of Quincy that it has had the benefit of economies of electric service pumps.

Three New Mills in Joplin District

The Century Zinc Co., Baxter Springs, Kan., has completed and placed in operation its new mill on the Bingham land, just south of town. The mill is thoroughly modern, being equipped with a large crushing plant and a modern flotation plant. J. L. Nelson, formerly in charge of the company's Wilson mine, is in general charge at the Bingham, with Kern Byrd in charge of the mill. The Century Zinc Co. now has seven properties producing in this district. It is a subsidiary of the Vinegar Hill Zinc Co.

The Tulsa Lead & Zinc Co., Tulsa, Okla., which was organized about a year ago to take over the old Mogul mine, and which has been decidedly successful in the development of that property, has recently taken over the sludge mill and lease of the Homestake mine, west of Baxter Springs, Kan. The Tulsa company also took over the old Virginia mill a few months ago, revamped the concentrator into a sludge mill, and has been making excellent recoveries from the Virginia tailings.

It is expected that the new mill of the Kansas Explorations Co. on the Ritz lease, and that of the Lawyers Mining Co. on the DeArmon lease, will be ready for operation by the first of the year, though it is not likely they will be started up unless ore prices are satisfactory.

Iron-Ore Shipments Largest in History

Owing to unsettled weather conditions the shipments of iron ore from the Mesabi range will soon be completed. Although the temperature has reached close to the zero mark, the crushing and screening plants of the Oliver Iron Mining Co. at both Hibbing and Virginia, Minn., continue to operate, and shipments will be concluded about Nov. 27.

The Mesabi range will close one of the most remarkable years of its history. Because of the late opening of navigation, disappointment by the continuous low price of iron ore, and owing, also, to slack demand, shipments fell far below those of the spring of the year before. When the spring business slump changed to a summer of unusual activity, demand for iron ore increased and shipments rose. The October total was the best in the history of the iron ranges. Though early spring estimates were for a season tonnage of 48,000,000, indications now are that this will approach 60,000,000.

A. Guthrie & Co., contractors, are busy loading a 350-ton steam shovel at the Corsica mine to move to the Wade mine of the Cleveland Cliffs Iron Co., where they have a contract to strip 300,000 yards of overburden and load about 500,000 tons of ore in the next two years. The Wade mine has been idle since 1920, the only activity there being the shipment of a stockpile.

About a half mile south of the present Glen mine near Chisholm, Minn., the Oliver Iron Mining Co. will soon start sinking a new shaft and begin other development work in connection with opening of a new mine. The name of this mine will be "Godfrey," in honor of M. H. Godfrey, district manager of the Oliver Iron Mining Co. All equipment will be up to date, with a steel shafthouse and electric machinery. It is estimated this work will be completed and the first ore shipped within a year. This work will not mean an increase in the number of men employed in the Chisholm district, but will take care of those out of work at other properties near there.

Champion Mine Optioned

The Champion Mine, Kenora, in Western Ontario, has been taken under option by Kirby Thomas for New York interests. Sam Hugh Brockunier, of Boston, made an examination of the property recently. The mine is developed to 150 ft. in depth and produced considerable gold ore several years ago. It was recently reopened by the Buffalo owners. Work will be continued.

Palisades Mines Co. Operating New Mill

The Palisades Mines Co., Calistoga, Calif., is now operating its new 75-ton mill, the equipment of which consists of a 20x10 Blake type rock crusher, one No. 54 Marcy mill, and a 5x18 ft. tube mill. The 200-mesh product goes direct from the tube mill to the cyanide plant.

Moore Mine Levies Assessment

During the last three months, August to October, inclusive, the Moore Mining Co., Jackson, Calif., milled 6,863 tons of ore, recovering $41,819 or $6.09 per ton. Gross value of the ore was $7.53. Total costs were $8.76 per ton, including plant additions, shaft and mine repairs, development, and exploration, these items totaling $4.53 per ton; operating cost was $3.55 per ton. The deficit was $2.67 per ton. The orebody encountered on the 1,800 level is being stoped at the 1,800 and 1,650 levels, and a station has been cut for the 1,500 level. A crosscut is being extended to the new oreshoot at the 950 level. An assessment has been levied.

Mill of the Palisades Mines Co., Calistoga, Calif.

Keweenaw Copper Calls Special Meeting of Stockholders

A special meeting of the stockholders of the Keweenaw Copper Co. has been called for Dec. 15 at Calumet, Mich., for the purpose of authorizing and empowering the board of directors to execute an option or options for the sale of property.

A special meeting of the stockholders of the Keweenaw Central Railroad Co. also is called for Dec. 15 to consider the sale of rights-of-way and tracks.

There is a disposition to link up both of the proposed sales with the reopening of the old Cliff property by Calumet & Hecla Consolidated, which will utilize the Keweenaw Central tracks, and with the negotiations for the sale of the lands of the Ashbed and Arnold companies in Keweenaw County, Mich.

Safety-First Celebration of the Moctezuma Copper Co.

Interest Maintained Through Competition and Prizes, Fostered by Safety Committees

FOR THE LAST TWO YEARS all the mining branches of the Phelps Dodge Corporation situated in Arizona, New Mexico, and the northern part of the State of Sonora, Mexico, have been engaged in an intensive campaign of establishing the principles and practices of safety first—and of accident prevention — among their employees. Excellent results have rewarded this campaign, and it has been gratifying to note the intelligence and marked interest in safety displayed by the men employed at the various properties. All injured men, whether seriously maimed or only slightly hurt (that is, from a light scratch—just drawing blood, for instance), are required to report at once to the local hospital. A time-lost accident, however, is considered as being one which prevents the injured party from returning to work the day following the accident.

A careful record of all accidents is kept, and equal attention is given to the prevention of serious and slight accidents. Compilations of the comparative accident statistics from the various corporation branches are sent out to all branches each month from the Douglas office of P. G. Beckett, vice-president and general manager. These comparative figures are based upon the number of accidents occurring per 1,000 man-shifts worked by all employees. Further to stimulate interest in the safety campaign, competition among the four metal-mining branches of the corporation was announced by Mr. Beckett toward the close of 1925 and to be in effect for the entire calendar year of 1926. Awards (bronze safety trophies) are to be made to each department, such as underground mining, concentrating, smelting, power house, machine shops, and other departments having the best safety record for the year. One grand sweepstakes trophy is also offered, this to take into consideration the entire payroll of the individual branches, to that particular branch which may show the lowest rate of time-lost accidents during the entire year.

For the first ten months of this year statistics show the combined departments of the Moctezuma Copper Co. (operating at Pilares de Nacozari and Nacozari de Garcia, Sonora, Mexico) to be leading, with the low record of 0.169 time-lost accidents per 1,000 man-shifts worked, and a total of only 79 such accidents throughout the period, during which 466,000 man-shifts have been worked. Most of the individual departments of that company are also leading.

June 15, 1926, completed a period of thirty-two consecutive days during which not a single time-lost accident occurred among all of the Pilares employees—this including all underground, shops as well as surface departments at this mine. During this time over 39,000 man-shifts were worked. In recognition of this excellent record, Frank Ayer, manager of the Moctezuma Copper Co., announced a day of "fiesta," including an evening dance, a barbecue, and other special features for all Pilares workmen and their families, all expenses of which were borne by the company.

Oct. 20, 1926, completed a period of 120 consecutive days during which not a single time-lost accident occured among the total number of Nacozari employees, including all workmen at the concentrator, power house, mechanical shops, railway shops, offices, and other departments. During this time practically 145,000 man-shifts had been worked. In recognition of this performance the Moctezuma Copper Co. again volunteered to bear all expenses of a suitable celebration to include all Nacozari employees and their families. The various safety-first committees of the Nacozari employees were asked to handle all arrangements through a special committee elected and appointed by them. W. T. MacDonald, mill superintendent and secretary of the Moctezuma Copper Co.'s General Safety Committee, acted as chairman of the special committee, which was composed of native representatives of the different departmental safety committees.

Much interest was manifested in the celebration, which included an evening dance at the company recreation building and at which not fewer than 1,000 people were present. It so happened that the large Mexican circus of Señor Alberto Fernandi was to be in Nacozari at this time, and arrangements were made whereby a special performance was given entirely for the Nacozari employees and their families. Fifteen hundred tickets were issued to employees.

It may be worth noting, also, that a further period of thirteen consecutive days without a lost-time accident followed this fiesta, thus making a total period of 133 days during which no such accident occurred among the Nacozari employees.

Auto Road Between Mazatlan and Durango Nears Completion

A geological commission recently appointed by the federal government to make a survey of the mining regions adjacent to the new automobile road between Durango and Mazatlan reports very favorably on the sections of Durango about San Vincente, Tayortita, El Favor, Santa Lucrecia, Panuco, and Contrastaca. Unfavorable reports are returned against the territory around Pueblo Nuevo, Ventanas, Metates, Conala and San Cayatano. The commission believes that, despite present unfavorable conditions in general, the high grade of ores and importance of deposits found in the first-named sections would justify immediate operations. The automobile road, which is well under construction from both ends, is expected to be in operation from Durango to Mazatlan by the first of June, 1927.

Mexico Letter

By W. L. Vail

Special Correspondent

Congress Discusses Relief for Mining Industry—Economies in Operation Recommended

City of Mexico, Nov. 13 — After a careful, deliberate, and conscientious study of the perplexing effects of the depression of silver on mining conditions throughout the republic, the Mexican Minister of Commerce, Labor and Industry has decided that the decline in the price of silver is a natural result of the immutable law of supply and demand.

Suggestions from this department for possible relief to Mexico's most important industry are: (1) A general and drastic reduction in salaries of the higher officials of the mining companies; reduction of all overhead expenses to a minimum with more intense and economic methods for production; (2) a temporary reduction in the present excessive quotas of taxation on all metals wherein silver notably predominates; (3) a reduction in freight rates on ores and supplies and metals; (4) gradual reduction of day labor at the mines, preferably a reduction in working hours and days of work rather than the discharge of any considerable number of workers.

In the meantime Congress is still occupied in discussing the bill for relief submitted some time ago by the President and in modifying the provisions of the new labor law, which is intimately identified with any provisions for betterment of the mining situation.

Exports of all kinds of metals for the first three months of this year show an increase of 21,167,576 kilos over the corresponding period of 1925. Lead took the lead, with 51,233,836 kilos for the period named; copper was second, with 10,551,889 kilos; zinc, 16,619,608 kilos; silver, 758,354; and gold, 7,236 kilos.

Figures are given also as follows, showing the taxes collected from all minerals from 1919 to 1925.

Mexican Mineral Taxes

1919	$15,150,018
1920	15,242,975
1921	4,496,871
1922	8,517,248
1923	9,847,237
1924	10,322,401
1925	11,950,991

As an interesting item, the taxes for the last year on the different metals are published: Silver, 8,331,193 pesos, gold, 1,028,597 pesos, all others 2,591,201 pesos.

Reports from the district of Totolopam, State of Oaxaca, are that the Guacama mine has struck a good grade of ore at the 635 level; that the San Pablo has completed and is now working its new 100-ton mill, and has enough ore in sight to run three years. The ore, it is claimed, assays over one kilo in silver across a four-foot vein, with occasional streaks of high-grade shipping ore. It is also reported that McEwen and Reid, of the same camp, have struck a good body of ore at the 500 level of their Noche Bueno property.

London Letter

By W. A. Doman
Special Correspondent

Wanderer Gold Under Option—Wiluna Mines Hopeful of Long Life

London, Nov. 9—On previous occasions I have mentioned the Wanderer Gold Mine, in Rhodesia. Some years ago this was being worked as a low-grade property, and was finally shut down because it could not be operated at a profit. It was acquired for a song by a party who believed that its potentialities had not received a thorough testing, and after much exploitation its prospects were thought to be favorable. As a result, the Gold Fields Rhodesian Development Co., took a working option over it, which has another eight or nine months to run. Lord Harris, the chairman of the Development company, stated at the meeting last week that although the terms of the option were somewhat onerous, the price was agreed to on the advice of the company's consulting engineer. He said the price would be justified if testing confirmed the owners' estimate of probable ore content and values. Favorable indications have been reported.

Rhodesia has also been well to the front by the advance in the price of Globe & Phoenix shares, which have risen to about 19s. 6d. on unofficial reports of a high-grade discovery that would virtually mean a new mine. The directors of the company seldom take notice of rumors, of which the mine has for long been the sport, but on the present occasion, as they were without news, they cabled to the manager to inquire about the position. His reply was laconic—"Deny; there is nothing in it." The shares suffered a relapse, but they have recovered again, to some extent on buying from South Africa, so that the market is now awaiting the usual development report.

As new discoveries of tin would be valuable, Africa is being searched in various directions, and apart from the Transvaal a new find is reported in Uganda. Although little is known, a company—the Ankole Tin—has been formed, and as showing the keenness of the public for tin shares there was an oversubscription almost immediately.

Although the West Australian Government desires the revival of mining in the State, local capital is shy of taking any part in it, possibly on account of labor conditions. Prothero Jones, managing director, has endeavored to raise funds for the Golden Horseshoe, and has proved unsuccessful. He is consequently returning to London.

I have had a conversation with A. H. Collier, who is responsible for the Wiluna Mines, in the East Murchison field. He is enthusiastic over the prospects, and thinks that the financiers and companies who have ventured their capital in it will eventually do well. He says that there is no difficulty as regards labor, for owing to the width of the lodes and their values, men are assured of profitable employment for many years to come. Work is now proceeding to test values in depth.

A rumor reaches me which, although it does not refer to base-metal mining, is interesting. The shares of the Apex Trinidad Oil Co. have risen very substantially on the London Stock Exchange within the last fortnight or three weeks. The story going round is that a company is in process of formation to amalgamate an oil property held by the New Consolidated Goldfields, the Apex Trinidad, and the Spies Petroleum. The Spies Petroleum is mainly a Russian undertaking, but the company owns a property in Trinidad. Another fusion rumor is that of the Gold Coast Amalgamated Mines with the Gold Mines Investment Co. Both are in the offices of the Consolidated Goldfields.

Production of Non-Metallic Minerals in Canada, 1925

Item	Unit of Measure	Quantity, Tons	Value
Actinolite	Tons	40	$500
Barytes	Tons	95	2,259
Bituminous sands	Tons	1,148	4,594
Fluorspar	Tons	3,886	19,234
Graphite	Tons	2,369	15,763
Magnesite	Tons	5,576	122,325
Natre-alunite	Tons	20	1,000
Peat	Tons	1,370	8,394
Phosphate	Tons	16	189
Pyrites	Tons	15,605	58,899
Sodium carbonate	Tons	1,120	8,140
Sodium sulphate	Tons	3,876	19,380
Mineral waters	Imp. Gals.	190,134	28,413
Total	.....	....	432,090

Gaspe Peninsula Contains Lead, Zinc, and Copper Ores

The mineral possibilities of the Gaspe Peninsula, that part of the Province of Quebec which lies south of the St. Lawrence River and east of the Matapedia River, are dealt with in a report just issued by the Natural Resources Intelligence Service of the Canadian Government, which follows in part:

"From a geological point of view, the conditions in Gaspe are encouraging to the prospector in search of ore deposits. The intrusion of a granite batholith with its subsidiary apophyses of porphyry and syenite into a thick series of sedimentary rocks is likely to have produced mineralization of some kind. The sulphides opened up on the Federal property show that such mineralization did take place, and it is to be expected that other bodies of ore will be found in the neighborhood of these instrusive masses. Until recently little prospecting has been done in the interior of Gaspe. The Federal vein, as exposed on the 100 level, contains 8 per cent metallic zinc and 4 per cent metallic lead.

"Copper deposits, both native and sulphide, have been found in Gaspe. Native copper in basic volcanic rock near Matane has been known for many years, and recently development work has been carried out on certain showings. The amounts of ore exposed as yet are small, but future prospecting may reveal larger bodies. On the headwaters of York River a number of claims have been recently taken up."

Johannesburg Letter

By John Watson
Special Correspondent

Senators Visit Rand Gold Mines and Witbank Collieries

Johannesburg, Oct. 19 — Onverwacht Platinum, Ltd., milled 1,370 tons of ore for September, yielding 562 oz. of platinum and allied metals, equivalent to 8.2 dwt. per ton milled. Crosscutting on the 350 level is progressing but not yet completed. The average value of the payable area proved to date on that horizon is 4.0 dwt.

About fifty Senators and members of the Legislative Assembly of this Union arrived at Johannesburg on Oct. 12, in response to the invitation of the Transvaal Chamber of Mines, to visit the Rand, as the chamber's guests, to become more practically acquainted with the position of this great industry. The previous visit of legislators proved a great success, and, on this present occasion, similar arrangements have been carried out. On the first night there was an informal dinner at the Carlton Hotel, to enable the legislators to meet the mining representatives. On Wednesday the party divided into four units and visits were paid to the Crown Mines, the East Rand Proprietary, the Government Areas, and Springs Mines. In the evening the visitors attended His Majesty's Theatre. On Thursday visits were paid to the Witwatersrand Native Labor Association's Compound, the Exchange Yard (for timber), the South African Institute of Medical Research, the Miners Phthisis Bureau and the Rand Refinery, Ltd.

On Thursday, at midnight, a special train left Johannesburg for Witbank, where the legislators visited the collieries and new electric power station. There was a luncheon at Witbank, the visitors returning to Johannesburg in the afternoon. The South African Institution of Engineers entertained the legislators and leaders of the Mining Industry at a dinner in the evening at the Carlton Hotel. At the Rand Refinery, on Oct. 14, the visitors were received, in two separate parties, by the acting manager and the superintendent. During 1924 ten million ounces of refined gold passed through the refinery, representing a total value of £40,000,000. Senator Steyl, one of the visitors, said he had known the Rand since its beginning, but had not realized how far it had progressed.

On the Johannesburg Stock Exchange during the last week the leading gold shares have had an easier tendency. London business was moderate in amount. Sub-Nigels declined during the week from 62s. 9d. to 62s. 3d. Lace Proprietary shares were a big feature (owing to their holdings in the Nigel district); their price rose from 14s. 10½d. to 15s. 4½d., a gain of 6d on the week's balance. Potgietersrust platinum shares have fallen from 9s. to 8s. 1d. A rumor was current on Oct. 14 to the effect that another million shares will be issued to take in the Rustenburg and Premier Rustenburg platinum companies.

Societies, Addresses, and Reports

Consumption of Regeants Used in Flotation, 1925*

Ore Treated by Flotation, 45,490,331 Tons; Chemicals Used, 81,666,967 Lb., of which Sulphuric Acid Was One-half

By Thomas Varley[1]
Salt Lake City, Utah

DATA on the consumption of reagents used in flotation during the year 1925, in metallurgical plants in the United States, are presented in this paper. Previous reports have covered the same subject for the years 1916, 1919, 1923, and 1924. The data contained herein show departures most radical from even the 1924 practice. Flotation has developed rapidly and on a more scientific basis than ever before. Perhaps more fundamental and useful data have been uncovered during the last two years than in all the years the art has been practiced.

In past years flotation has been referred to generally as "oil flotation"—today it might be more properly called "chemical flotation." Minerals can be floated today without oil. Chemicals alone will do the work, showing how little was truly known about the process heretofore. The term "reagents," as used herein, includes both chemicals and oils.

Another outstanding feature regarding the use of flotation reagents is the radical drop in "pounds per ton" of reagent used in 1925 as against 1924. The figure for 1923 was 4.2680 lb. of total reagents per ton of ore treated, for 1924 it was 3.9618 lb., and for 1925 it was 1.7952 lb. per ton of ore treated. The principal reason for this decrease in amount required to treat a ton of ore is that crude oils, heavy oils, and acids have practically been eliminated. Chemicals, many under trade names such as xanthate, T & T (a mixture of orthotoluidine and thiocarbanilid), X-Y mixtures and others, are generally used. For differential flotation cyanide, zinc sulphate, and copper sulphate are largely used as either depressing or accelerating reagents.

The year 1925 saw the passing from acid to alkaline circuits. Chemical flotation agents and conditioning agents have proved far more effective when used in alkaline pulps. Lime, as compared with acid, is much cheaper, and can be handled and stored much more easily and safely than acid. Lime can be manufactured in almost any locality, and procured more readily than acid. Nearly all big operators have their own lime plants now and several are manufacturing their own reagents.

Concentration Ratios—The ratio of concentration in flotation is comparatively high because high-grade products are constantly being obtained more free from undesirable minerals and gangue than heretofore. This is shown by the reports previously published. The summary of 1925 figures shows that the total quantity of ore reported as being treated by flotation in that year was 45,490,331 tons, from which 2,790,526 tons of concentrates were obtained, giving an average concentration ratio of 16.301 tons into 1. This ratio[2] is much less than that for the 1924 figures, which was 19.626 to 1, and is lower than that for 1923, which was 17.730 to 1. The low average ratio for 1925 is partly due to the increased tonnage of lead-zinc-iron ores treated. Some of these ores are more than 50 per cent mineral, and by the removal of three concentrates—namely, lead, zinc, and iron products—the concentration ratio is reduced materially.

Quantity of Ore Milled and Consumption of Reagents Used in Flotation in the United States, During the Calendar Year 1925

Total number of companies reporting	93
Total ore milled (includes flotation), tons	59,370,177
Total concentrates produced by methods other than flotation, tons	2,103,767
Total ore treated by flotation, tons	45,490,331
Total concentrates produced by flotation, tons	2,790,526
Concentration ratio by flotation	16.301 to 1
Total reagents consumed (all kinds), lb.	81,666,967
Equivalent in pounds per ton ore	1.7952

Reagents	Pounds
Pine oil	4,279,229
Xanthate	4,029,846
Lime	2,166,819
Refined coal-tar oils	4,517,591
Reconstructed oils	9,694,880
Crude oils	420,837
Hardwood creosotes	4,805,555
Sulphuric acid	40,028,170
Orthotoluidine and thiocarbanil d	83,353
Cresyl c ac d	210,235
Sodium and barium sulphide and calcium polysulphide	5,532,089
Sodium silicate	291,047
Tarol	8,400
Soda ash	1,566,482
Aldol	9,203
Copper sulphate	1,543,686
T & T mixture	327,490
Sodium sulphite	57,685
X-Y mixture	20,055
Zinc sulphate	1,045,342
Cyanide	265,966
Miscellaneous	763,007
Total reagents consumed	81,666,967

The data here summarized were collected by special canvass of mill operators and the summary is as complete as figures will permit. In some plants where gravity concentration is still in use, the operators reporting have had to estimate the tonnage going to flotation. Over 95 per cent of the tonnages reported are actual figures reported to the fraction of a ton, and 5 per cent are those closely estimated by operators.

Gravity Concentration.—In the general summary table for all ores, as well as summaries for the different classes of ores, are shown figures for "total tonnage of ore treated"; also "tonnage of concentrates treated by means other than flotation." In many mills the ore is crushed, classified, and treated by gravity concentration. Some mills discard tailings without regrinding; others regrind tailings and treat by flotation. Thus, from figures in the general summary it can be ascertained that 11,776,079 tons of tailings was discarded without flotation treatment. This figure is obtained by deducting from 59,370,177 tons, which was the total quantity milled by all processes, the sum of 2,103,767 tons, the quantity of concentrates produced by means other than flotation, plus 45,490,331, the quantity of ore treated by flotation, leaving a difference of 11,776,079 tons that were not put through flotation plants.

Gold-Silver Ores—Reports from seven operators treating gold-silver ores were received. The ore treated totaled 484,924 tons, from which 36,445 tons of concentrates was produced, with a concentration ratio of 13.306 tons into 1. The quantities of reagents used are shown, but have not been calculated into "pounds per ton of ore," because of the fact that the same reagents were not used in each mill.

Reagents (1925), Gold-Silver Ores

	Pounds
Hardwood creosote	80,241
Xanthate	32,186
Pine oil	49,798
Cresylic acid	18,697
Sodium sulphide	49,687
Lime	17,765
Coal-tar creosotes, refined	134,179
Orthotoluidine and thiocarbanilid	10,603
Crude oil	30,500
Sulphuric acid	15,600
Cyanide	5,500
Aldol	9,203
Total	453,959

Silver-Lead Ores—The type of ores classed under this list includes those whose principal valuable metals are silver and lead, and from which no zinc is recovered. Most of the ores listed are free from zinc; others contain such a small amount that no attempt is made to recover it.

A few of the plants operate on straight sulphide ores, while the greater number are treating either straight oxidized ores or partly oxidized and partly sulphidized ores. This accounts for the large amount of sodium and barium sulphide used, which is added to the pulps to sulphidize the oxidized minerals in the ore and render them amenable to flotation treatment. The total tonnage of ore milled was 1,295,228 tons by gravity concentration, from which 97,875 tons of concentrates was produced. Of the total tonnage milled only 49.15 per cent, or 636,628 tons, was treated by flotation, from which 70,813 tons of concentrates was produced. The ratio of concentration by flotation was 8.990 tons into 1. Seventeen operating mills are included in this summary.

Reagents (1925), Silver-Lead Ores

	Pounds
Pine oil	53,179
Coal-tar creosotes, refined	120,222
Xanthate	100,906
Wood creosotes	34,327
Cresylic acid	2,575
Sodium and barium sulphide	929,616
Sodium silicate	141,720
Crude oil	49,940
Lime	826,750
Tarol	8,400
Total	2,267,635

*Condensed from Serial No. 2777, published by the Bureau of Mines, U. S. Department of Commerce.

[1]Metallurgist, Bureau of Mines, Department of Commerce.

[2]Serial No. 2709 publishing data for 1923 and 1924 put these figures at 13.04 to 1 for 1923 and 15.28 to 1 for 1924. This was an error due to calculating the total concentration ratio, both gravity and flotation.

Copper Ores—Twenty-one operators reported the treatment of 46,175,198 tons of copper ore for the year, from which 1,597,022 tons of concentrates was produced by gravity methods. This figure includes, also, the tonnage treated by flotation.

The ore treated by flotation was 40,576,067 tons, from which 2,166,557 tons of flotation concentrates was obtained, showing a concentration ratio of 18.728 tons into 1. The calculated assay of the flotation tonnage was 1.3002 per cent copper.

Comparative Flotation Data

	1923	1924	1925
Tons treated	35,716,466	42,105,335	40,576,067
Assay per cent copper	1.3675	1.4127	1.3002
Concentration ratio	18.57–1	21.34–1	18.728–1

The following list shows quantities of reagents used. The figures were so varied, however, and changes in reagents at the same plants were so radical, that if the various reagents were calculated into "pounds per ton" the results would be misleading.

Reagents (1925), Copper Ores

	Pounds
Pine oil	3,637,261
Xanthate	3,696,951
Lime	84,390
Refined coal-tar oils	3,875,500
Reconstructed oils	9,694,880
Barium and sodium sulphide and calcium polysulphide	4,335,424
Crude oils	340,397
Hardwood creosotes	4,159,271
Sulphuric acid	39,868,154
Orthotoluidine and thiocarbanilid	51,610
Zinc sulphate	7,735
Miscellaneous reagents, including sodium phosphate, sulphur and xylidine	75,422
Total	69,826,995

Lead Ores—The ores classified here as lead ores are comparatively free from minerals of other metals such as silver, zinc, iron, and copper, and are kept separate from the other ores in tabulating the data, for the reason that their flotation is comparatively simple and fewer reagents are used. In milling this class of ore gravity concentration is an important factor, for the reason that high-grade coarse concentrates can be produced and large tonnages of tailings, low in metal content, can be discarded at comparatively coarse crushing sizes. Only the natural slimes and the recrushed middlings go to the flotation plants. A total of 6,120,716 tons of ore of this type was milled during the year, from which 224,358 tons of concentrates was produced by gravity concentration, the concentration ratio being 27.28 tons into 1.

The tonnage treated by flotation was 1,793,547 tons, from which 175,713 tons of concentrates was produced with a concentration ratio of 10.207 tons into 1.

Reagents (1925), Lead Ores

	Pounds
Pine oil	273,769
Wood creosote	462,536
Xanthate	38,980
Cyanide	53,838
Soda ash	27,770
Other oils and reagents, special mixtures composition not given	22,866
Total	879,759

Lead-Zinc-Iron Ores—This type of ore represents the real complex lead-zinc-iron sulphide variety, in which the minerals are closely associated with each other as well as with the gangue material. Silver is also a valuable constituent of this type of ore. It is this class of ore on which differential separation of the minerals has been highly and successfully developed the past two years.

As a source of zinc for the electrolytic zinc smelters this material is paramount. The lead products are removed for the lead smelters, and at present zinc products are obtained assaying 50 to 57 per cent in zinc with recoveries up to 85 per cent of the total zinc in the ores treated. The lead recoveries are even higher than the zinc.

Desirable lead products are recovered quite free from zinc, and products high in iron are also made. These iron concentrates, which contain small amounts of lead and appreciable amounts of silver, furnish desirable iron ores for fluxing purposes, either in lead or copper smelters. The total ore of this kind milled by all methods during the year was 2,203,313 tons. A few operators still use gravity methods of ore dressing, supplemented by flotation. Ore treated by flotation was 1,432,264 tons, from which 134,257 tons of lead concentrates and 168,445 tons of zinc concentrates were produced. The iron concentrate produced was not reported in each case, so the total is not available. The concentration ratio (calculating lead and zinc products only) was 4.731 tons into 1. Reagents varied considerably during the year, many plants changing their practice completely regarding chemicals and oils.

Reagents (1925), Lead-Zinc-Iron Ores

	Pounds
Pine oil	169,325
Coal-tar creosotes	221,903
Hardwood creosotes	69,180
Copper sulphate	1,274,091
Cyanide	206,628
Zinc sulphate	1,037,607
Xanthate	128,900
T and T mixture	327,490
Soda ash	1,538,712
Lime	1,237,914
Cresylic acid	188,713
Sulphuric acid	144,416
Sodium sulphide	217,362
Sodium silicate	148,727
Sodium sulphite	57,685
Miscellaneous (includes crude and gas oil and X-Y mixture)	88,583
Total	7,057,236

Zinc and Lead-Zinc Ores—This type of ore represents largely that found in the Middle West, particularly the Tri-State district of Missouri, Kansas, and Oklahoma. The milling practice has improved materially in the last three years, and most of the mills are supplementing their gravity milling by flotation. Though regrinding of tailings has not been as yet instituted, the middling products that are reground, and also the natural slimes, are now treated by flotation, which adds materially to profits by increased metal recoveries.

The lead content is all removed by gravity concentration and generally only zinc concentrates are produced by flotation. There are, however, a few mills in this district which produce both a lead and a zinc concentrate by differential flotation, but the ores treated in these mills have been classed under the lead-zinc ores and are not included in this tabulation.

Quantities of Ore Treated by Flotation, 1925

	Total Treated, Tons	Treated by Flotation, Tons	Concentrate (Flotation), Tons	Concentrate by Other Methods, Tons
Gold-silver ores	484,924	484,924	36,445	.....
Copper ores	46,175,198	40,576,067	2,166,557	1,597,022
Silver-lead ores	1,295,228	636,628	70,813	97,875
Lead ores	6,120,716	1,793,547	175,713	224,358
Lead-zinc-iron ores	2,203,313	1,432,264	134,257Pb 168,445Zn .....Fe	....
Zinc and lead-zinc ores	2,972,894	448,997	.....	Pb 22,224
			28,790	Zn 162,288
Miscellaneous	117,904	117,904	9,506	.....
Total	59,370,177	45,490,331	2,790,526	2,103,767

The total amount of zinc and lead-zinc ores milled, as reported for the year 1925, was 2,972,894 tons, from which 22,224 tons of lead concentrates and 162,288 tons of zinc concentrates were produced by gravity methods. The concentration ratio by gravity methods was 16.112 tons into 1.

There was treated by flotation 448,997 tons of ore, from which 28,790 tons of flotation zinc concentrates was produced, showing a concentration ratio by flotation of 15.595 tons into 1. The list of reagents used is:

Reagents (1925), Zinc and Lead-Zinc Ores

	Pounds
Copper sulphate	269,595
Xanthate	31,923
Pine oil	95,897
Coal-tar creosotes, refined	165,787
Miscellaneous	42,045
Total	605,24

Miscellaneous Ores—These include graphite, molybdenum, and a few of the rare mineral ores. The material reported as being treated by flotation was 117,904 tons, from which 9,506 tons of concentrates was produced, with a concentration ratio of 12.40 tons into 1.

The total amount of reagents used was 576,136 lb., and consists of numerous oils and chemicals. Exact data have been held as confidential at the request of the operating companies.

American Petroleum Institute Will Meet at Tulsa

The annual meeting of the American Petroleum Institute at Tulsa, Okla., Dec. 7, 8 and 9 will draw leaders in widley varied lines of industrial and scientific activity.

The convention's keynote will be co-operation and co-ordination among all these participating interests. Everything that looks to less expense and greater proficiency in production, manufacturing, distribution, and utilization will have attention.

Idaho Names Delegates to Mining Congress Convention

Governor C. C. Moore of Idaho has appointed delegates to attend the annual convention of the American Mining Congress, which will be held in Washington, D. C., Dec. 7 to 10, inclusive. In his letter notifying appointees, the Governor says: "The discussions of this session will include a consideration of the problem of the public land states respecting the right of these states to control the lands within their own borders, a subject of unusual importance to all who are engaged in mining."

The delegates named follow: Stewart Cambell, Boise, state mine inspector; Ravenel Macbeth, Mackay; I. E. Rockwell, Bellevue; C. E. Nighman, Conda; D. L. Nichols, Salmon; M. E. Willmott, Clayton; A. H. Burroughs, Jr., Talache; Stanly A. Easton, Kellogg; Jerome J. Day, James F. McCarthy, N. C. Sheridan, C. D. Newton, Alfred J. Dunn, Harry L. Day, all of Wallace; C. L. Herrick, Mullan; and J. H. Richards and Robert N. Bell, Boise.

Mining Congress Convention in December

The twenty-ninth annual convention of the American Mining Congress will be held at the Hotel Mayflower, Washington, D. C., Dec. 7 to 10, inclusive. The program that has been suggested by the directors includes a discussion of the following subjects: "Stabilizing Mineral Production," "Politics and Natural Resources," "Mine Taxation," "A Unified Labor Platform," "Elimination of High Production Costs Through Simplified Methods and Equipment." Plenty of entertainment will be provided for delegates, and special entertainment is being arranged for the ladies. This includes golf, theatre, luncheons, dinners, and dancing.

Research Work Stressed at Michigan Engineering Society Meet

Pointing to the need for public interest in perpetuating the mining industry of the upper peninsula of Michigan, Dr. W. O. Hotchkiss, president of the Michigan College of Mines, Houghton, who spoke at the annual dinner of the Michigan Engineering Society at Lansing on Nov. 19, on "The Mineral Resources of Michigan," stated that over half the total income of the people of northern Michigan comes from the mines—from the sale of iron ore and copper.

"Not only is it important to the upper peninsula of Michigan to insure the continuation of our copper and iron industry," said Dr. Hotchkiss. "It is also of vital importance to those many times greater groups of people who are employed in the great industries dependent on iron, steel, and copper. Perpetuation of the mining industry in northern Michigan is a matter of lesser importance to any single mining company than it is to the manufacturing industries and the public as a whole.

"Everyone knows that the time will come when every mine now operating in Michigan will hoist its last ton of ore. If the mining industry is to continue, we must find new bodies to replace those mined out, as well as economical methods of making merchantable ore from the billions upon billions of tons of low-grade material which is now of no value. This will require intelligent interest and support from the public.

"The state Geological Survey for many years has not had adequate funds to carry on geologic work that we need to promote prospecting. It has accumulated much information, but has not been given money to publish its results. We have great geologic areas that offer promise for the future, both in the finding of new deposits of copper ores and in the finding of new bodies of iron ore.

"The future of our production of iron ore will be first extended by the finding of new bodies of merchantable ore. If the merchantable ore becomes scarce, which it will in due time, the next extension of our future will be accomplished by the development of methods of using our almost unlimited supplies of iron formation—the rock in which the iron orebodies are found and which carries from 25 to 40 per cent of iron.

"One of the first things needed is a careful, scientific study of all the available properties of the rocks in which our ores are found, so that we can learn the best and most effective methods which will lead us to find those new orebodies which we shall need within a relatively short term of years. The detail of all these subjects of research, the methods to follow to get the results we want, are subjects for deep consideration and much study."

Tri-State Producers Elect Officers

J. F. Robinson, of Miami, Okla., president of the Commerce Mining & Royalty Co., was re-elected president of the Tri-State Zinc & Lead Ore Producers' Association, at the annual election held recently at Picher, Okla., in the Joplin-Miami field.

C. F. Dike, of Joplin, manager of the Oklahoma Woodchuck and other properties, and Sidney H. Davis, of Baxter Springs, Kan., manager of the Vinegar Hill Zinc Co. in this field and of the Smith Davis Mining Co., were made vice-presidents.

Directors selected were P. B. Butler, O. W. Bilharz, George O. Pearson, H. W. Harrison, F. H. Kissling, T. F. Coyne, S. H. Davis, J. H. Robinson, C. F. Dike, George Provine, Charles A. Neal, Frank Childress, W. T. Landrum, M. F. Owens, and C. Y. Semple, all prominent mine owners or managers of the district.

South African Engineers Meet

At the monthly meeting of the South African Institution of Engineers, at Johannesburg, Oct. 13, R. Craib described the engineering task of dewatering the lower levels of the Simmer and Jack gold mine. The president, W. G. C. Nixon, congratulated the author on the valuable contribution he had made to the records of the institution.

Bureau of Standards' Twenty-fifth Anniversary

A celebration of the twenty-fifth anniversary of the Bureau of Standards of the Department of Commerce is just announced. On Saturday, Dec. 4, the bureau will keep open house, and a banquet will be given at which the many friends of the bureau will meet the staff and reminiscences will be exchanged, the achievements of the quarter century will be reviewed, and the present and future work will be discussed. A group of distinguished guests will attend.

The event is of interest to the world of science and as well to the industrial experts who have worked so closely in co-operation with the bureau and in turn made application of its discoveries and developments in perfecting the measured control of processes. The opportunity to inspect the experimental research facilities of the bureau will be welcomed by its many friends.

American Engineering Standards on Exhibition

The tremendous savings which standardization offers to American industry will be shown by the American Engineering Standards Committee in an exhibit at the Fifth National Exposition of Power and Mechanical Engineering to be held in the Grand Central Palace, in New York City, from Dec. 6 to 11, 1926.

Standardization of methods, of materials, and of dimensions in one factory is the time-honored method of reducing manufacturing costs in American industry. Standardization throughout an industry is more recent in conception; and a national plan of standardization in co-operation with the standardization program of other countries is only now finding its place in the manufacturing industries of the United States. The American Engineering Standards Committee is the great co-ordinating body for the promulgation of standards. Under its procedure 200 projects are under way with the co-operation of 350 national technical societies, trade organizations, and government departments. In the exhibit of the American Engineering Standards Committee at the Power Show, progress of these and other related fields will be demonstrated by interesting series of illustrated diagrams.

German Petroleum Institute

The Mining Academy at Clausthal, which has a chair of mining and petroleum drilling, is inviting German petroleum operators to consult it for solving the problem of getting a better yield from local wells. This institution is on a small scale, but in view of available crude oil in Germany it intends to follow the French example of forming an institute for the improvement of domestic wells. The need of a German institute is recognized in spite of the comparatively small crude yield from the Hanover wells, as the local industry considers that only about 15 to 20 per cent of the oil is recovered by present mining methods, according to reports to the Department of Commerce.

Recent Technical Publications

Reviews, Abstracts, and References

Transactions, A.I.M.E. Index to Volumes 5 to 72 inclusive; 1917-1925. Published by the Institute, 29 West 39th St., New York City. Price $5.

Without an index covering several volumes, the vast amount of information given in Institute papers and discussions remains buried for the most part, as one soon wearies of consulting the individual indices to the various weighty volumes. This is the third comprehensive index that has been published, the first covering volumes 1 to 35, and the second, 36 to 55. With the aid of these three books, reference may be made easily to any information on a given subject that the Institute may have published.

Practical Structural Design in Timber, Steel, and Concrete. Third edition, revised and enlarged. By Ernest McCullough. Scientific Book Corporation, New York City. Price $4.

More than 100 pages have been added to the previous edition of this work, and concrete work is given a concise treatment. The volume will be found useful to the construction engineer as well as to the student; it is comparatively free from abstruse mathematics and much good practical information is given.

Metallurgy. By E. L. Rhead. Longmans, Green & Co., New York City. Price $2.50.

This is an elementary textbook for the use of students in English schools. The various chapters cover the physical properties of metals, metallurgical terms and processes, furnace types, refractory materials, fuels, iron and iron smelting, steel, copper, lead, mercury, silver, gold, tin, zinc, antimony, and the minor metals, consideration being given to both the reduction of the various metals from their ores, and to their use. As the page size of the book is only 5 x 7 in. and the text pages number only 392, the treatment is little more than an outline. The practices described are, in some cases, obsolete in the United States, though, in its present edition, the book has been brought reasonably up to date in many respects.

Modern Drying Machinery. By H. B. Cronshaw. Ernest Benn, Ltd., 8 Bouverie Street, London, E. C. 4, England. Price 6s.

Though most of the machinery used for drying has nothing to do with the mining industries, being used in evaporating the water from fruits, vegetables, soap, fabrics, paper, grain, sugar, and various chemicals, nevertheless a large amount of drying machinery is used in the mining field. In this book, for example, are briefly described the principal machines used for drying loose granular materials such as coal, sand, rock, ores, slag, and cement materials; and also powders and sludges, such as flotation concentrate and filter cakes in precious-metal treatment plants. The treatment is essentially British, but some American machinery is mentioned. The volume is small, the text on each page measuring only 3x5¼ in., and as there are only 159 pages, the treatment is necessarily concise.

The Market Data Book. 1926-1927. Published by G. D. Crain, Jr., 537 S. Dearborn St., Chicago.

This book gives statistics of various classes of industries, in abbreviated form, but is essentially a directory of class, trade, and technical publications, giving the circulation, advertising and subscription rates, and other relevant data.

Statistical Abstract of the United States, 1925. U. S. Department of Commerce, Washington, D. C. Price $1 from the Superintendent of Documents, Washington, D. C.

This is the latest volume in the series, which is a digest of data collected by all statistical agencies of the national government, as well as those of several private agencies, and of one or two states. Statistics relating to mining and mineral products occupy 41 pages of this 800-page book.

Wood Preservation—The U. S. Forest Service has issued a bulletin on the "Quantity of Wood Treated and Preservatives Used in the United States in 1925," by R. K. Helphenstine, Jr. A total of 1,145,788 board feet of mine timbers is reported to have been treated during the year. An appendix gives a list of all the wood-preserving plants in North America, their location, the year built, and their equipment. Copies of this 40-page bulletin may be obtained on request from the Office of Forest Products, Department of Agriculture, Washington, D. C.

Sieve Specifications — Technologic Papers of the Bureau of Standards, No. 321 (price 5c. from the Superintendent of Documents, Washington, D. C.; pp. 9) is "A Study of Sieve Specifications," by Lewis V. Judson. An account is given of a study made on sieves tested by the Bureau of Standards which showed the desirability of changes in specifications, especially in regard to a wider tolerance in wire diameters.

Prospecting in Belgian Congo—In a review of a book, "Testing and Estimating Alluvials," recently published on this page, the reviewer said that other engineers should also publish the results of their work, for the common benefit. This bulletin, entitled "Guide Pratique pour la conduite des Prospections Aurifères dans la Région Minière de Kilo-Moto (Congo Belge)," is offered as a further contribution to this subject, describing work done on alluvial gold deposits in the Belgian Congo. The bulletin is of 58 pages and may be obtained from Société des Mines d'Or de Kilo-Moto, 3, Rue du Commerce, Brussels, Belgium.

Nova Scotia Shale—The National Research Council of Canada has recently issued Report No. 18, "Investigations on the Treatment of Nova Scotia Oil Shales," by A. E. Flynn, pp. 88. Copies are obtainable on request from the National Research Council, Ottawa, Ont.

Business Organization—The Policyholders' Service Bureau of the Metropolitan Life Insurance Co., New York, San Francisco, and Ottawa, is publishing for free distribution a series of booklets on business organization that may be of interest, particularly to some of the smaller mining companies and to those that are in process of formation. The first of the series dealt with the functions of the comptroller, the second with those of the treasurer, and the most recent with the duties of the transportation manager.

National Wealth—The Federal Trade Commission recently issued a 380-page report on "National Wealth and Income," which is available for 50c. from the Superintendent of Documents, Washington, D. C. The section on national wealth covers a general survey, distribution of wealth among individuals, ownership of natural resources, farm wealth, wealth of corporations, ownership of corporations, and wealth of nonprofit institutions. The section on income deals with personal and corporate income; total national income; agriculture; mining, manufacture, and construction; transportation and communication; and mercantile business.

Mexican Mines—*The Mexican Magazine* (Avenida Juarez 105, Mexico City; price 30 centavos) is publishing in each issue a list of the active mines in Mexico, with the name of the manager in each instance. The September issue contains the names of about 250 active properties.

Flotation of Gold Ores—The School of Mines, Kalgoorlie, Western Australia, has published two brief bulletins on the flotation of gold telluride ores and of pyritic gold ores. One is entitled "Laboratory Flotation of Kalgoorlie Ores," by A. S. Winter and B. H. Moore, and the other "Report of the Investigation Carried Out in the Pilot Plant of Oroya Links, Ltd., on Croesus Proprietary Gold-bearing Ore," also by Messrs. Winter and Moore. Xanthate was found not a particularly desirable reagent. Colloidal matter occasioned trouble, but it was controlled by the use of sea water.

Cyanidation—In the September *Bulletin* of the Institution of Mining and Metallurgy is an 11-page paper by Cecil J. Brooks on the "Solubility of Silica and Other Rock-forming Substances During Cyanidation." The author relates experiences with the treatment of oxidized ores of Sumatra. Copies of the paper are obtainable for 1s. each from the offices of the Institution, Cleveland House, 225 City Road, London, E. C. 1, England.

Physical Examination—"Physical Examinations in Industry," recently published by the Policyholders' Service Bureau, Metropolitan Life Insurance Co., New York City, for free circulation, discusses in detail the advantages of placing a man in a job for which he is physically fit, the purposes of physical examinations, their cost, and the manner of conducting them in industry. The lay-out of examination rooms is described, together with the necessary equipment and facilities.

Personals

Charles A. Mitke is in Colorado on professional business.

George Kingdon will sail for South American around the first of December.

R. D. Leisk, mining engineer, of Jerome, Ariz., sailed from New York on Nov. 20 for several months' professional work in Peru, Chile, and Bolivia.

Noah A. Timmins, president of the Hollinger Consolidated, who was recently in Winnipeg, may enter the central Manitoba mining field, where he is stated to have optioned a group of eight claims in the Stormy Lake district.

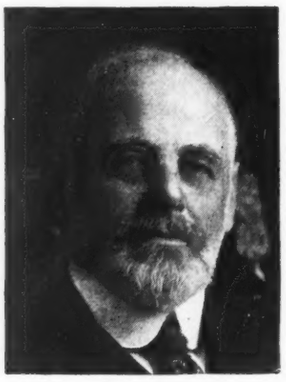
Dr. J. A. Bancroft, of McGill University, is going to Africa for two years, to make a geological study of Rhodesian copper deposits. It is understood that he will have five Canadian geologists with him, who have specialized in the Pre-Cambrian.

James Furman Kemp

By the sudden death of James Furman Kemp, on Nov. 17, an outstanding personality has been removed from the brotherhood of geologists and mining engineers. Born in 1859, Kemp graduated from Amherst College in 1881 and the Columbia School of Mines in 1884. After further study of mineralogy and petrography in Leipsic and Munich, he served as instructor and assistant professor of geology at Cornell University from 1886 to 1891. In the latter year he was appointed adjunct professor of geology at Columbia, becoming full professor in 1892, which position he held to his death.

By reason of his ability and energy Kemp soon became recognized as one of the world's leading geologists. That he was almost as well known in Europe as in his own country is attested by the impressive roll of his membership in, and official connection with, many technical and scientific societies both here and abroad. During his professional life, as teacher and mining geologist, he found time to write standard books on the "Ore Deposits of the United States and Canada" and on the "Constitution of Rocks," besides numerous papers on specific phases of geology and ore occurrence for scientific societies and the technical press. The summers of several years were spent in a detailed study of the geology of the Adirondack region of New York, and in recent years he was called upon as expert in connection with important mining litigation in Butte, Mont., and in the Lake Superior copper district. He was closely associated with the planning and development of the last addition to the New York water-supply system, being able to give skilled advice relative to the geological structure of the watersheds, as influencing the location and design of the new reservoirs and the aqueduct leading from them. Among his other activities were geological explorations in Porto Rico, South America, and the iron regions of Norway and Sweden. He was often consulted in questions relating to industrial geology.

But it is not particularly upon Kemp's professional career that we wish now to dwell. His personal qualities command equally our respect and admiration. What a lovable nature was his! Few men have had a wider circle of close friends. When he was appealed to for assistance, no personal effort was too great. Ungrudging, sympathetic helpfulness toward others was one of his outstanding characteristics. In every emergency he gave the best that was in him. He always found it hard, if not impossible, to say "no" when asked to do a favor or to assume some new responsibility, however exacting. Many will recall the hard task he undertook when urged to accept the presidency of the American Institute of Mining Engineers in 1914, at a time of stress due to the reorganization of



James Furman Kemp

that society. A long and serious illness, beginning in 1915, was probably largely the result of his labors during that period. But his vigorous physique, natural optimism, and the determination to live, aided by the devoted care of his wife, triumphed in the end, and his restored health gave promise of many more years of usefulness. Unhappily this promise has not been realized.

In endeavoring to give adequate expression to an estimate of Kemp's fine character and professional attainments, one is almost irresistibly impelled to use superlatives. But all who had the privilege of knowing him well will recognize the essential truth of the imperfect picture here presented. Over the many hundreds of students with whom he came in close contact in the course of his long professional career he exercised a marked and beneficial influence. If it were possible to secure their testimony, we should find it was the man himself that exerted the strongest appeal. "Uncle Jimmy," as he was affectionately called by his students, was the friend and adviser of every deserving member of a long succession of classes. This relationship was not confined to the classroom. Many will long remember the pleasant Sunday afternoon or evening gatherings at Uncle Jimmie's home, where the cordial, easy hospitality that always marked those occasions was especially appreciated by students who lived in lodgings or in the university dormitories.

Though geology is generally considered a dry subject, Kemp succeeded in illuminating it by his keen sense of humor, which often flashed out during his lectures in the form of apt illustrative anecdote or reminiscence. The same quality always made him acceptable as toastmaster or as an after-dinner speaker. It was his delight to take out parties of students for practice in field geology, both in the summer vacations and during term time as opportunity offered. Many will remember that on these expeditions his ability as a teacher was equaled by his prowess as a pedestrian. When tracing outcrops on a hot day, the stimulus of his example was often necessary to prevent less enthusiastic members of the party from constituting too numerous a rear guard.

The writer wonders if Kemp ever used a harsh expression. His gentle, kindly nature always expressed sympathy and tolerance of the views of others. His strong common sense made him a good adviser. Loyalty, duty and honor were the keynotes of his useful life. His death has caused the keenest feeling of personal loss to his friends and creates a gap in the ranks of Columbia's teaching staff that will be hard to fill.

ROBERT PEELE.

Almost a quarter of a century ago I came to Columbia to become the personal assistant and understudy of a man I had never seen. This was Professor James F. Kemp, of the Department of Geology. He welcomed me and mine as one would a long absent son rather than an utter stranger, and in our lonesomeness took us to his own home to wear off the bewilderment of our new surroundings. From the very first hour I was made to feel that he fully accepted me, and in his inimitable manner he hopefully said that we could look forward to many happy times together.

At the time I thought he must have detected the homesickness that was gnawing at my heart and had made a special effort to be consoling. Later I was to learn that such things were as normal for him as it was to breathe. Thus, it was my fine fortune to fall in with a remarkable man, one of the "salt of the earth," as he himself used to say of others, and with him I was privileged to work in a most intimate relation until the end of his life.

It is not given to many men to be dearly loved by a multitude of people, and perhaps it is still more rare to find a man whom everyone instinctively feels is his personal friend. Such a gift, however, was the fortune of Professor Kemp, whose death has brought a sense of bereavement to thousands of associates and former students.

Forty years of his life were devoted to service as a teacher, and he looked upon that service as one of the greatest privileges in the world. I have often heard him say that he would not give it up willingly for any other opportunity because of the touch it gave with young people at a critical time in their lives. Their gratitude, as time devel-

oped greater appreciation of this service, was enough remuneration to offset all other rewards for him.

Year after year this work of his has gone on in such a quiet way that one could hardly realize its far-reaching influence; but the happenings of the last few days have brought it all out in most striking manner, for the evidences of grief and expressions of appreciation have literally rained in on the survivors of his family and organization.

As a teacher Professor Kemp was a rare combination of kindliness and serious concern, coupled with a never-failing buoyancy and humor. He had a very broad acquaintance with his own and related fields of knowledge, and exceptional facility in presentation. He was almost never in want of the right word. His lectures were marked by literary skill, and his sentences always fell with smoothness and grace. An apt anecdote or illustration was habitually used to clarify the problem in hand.

His lectures were readily followed. His explanations were so fully developed that it was sometimes easy to underestimate the fundamental nature of the matters presented; but a little reflection always showed that not only were the principles included, but they were presented in a form that could not be misunderstood or readily forgotten.

The genial kindliness of the man and the personal attachment that always developed as acquaintance lengthened tended to overshadow the excellence of his other qualities as a teacher. As a consequence, his students developed a wish to speak of him in more endearing terms than those usually applied to an excellent instructor. This is the way the familiar name, "Uncle Jimmie," came. The "Professor Kemp" of the first day soon became "Uncle Jimmie," to stay unchanged to the end of the story. For more than twenty years I have known every class that passed through his hands, and have never seen an exception among them all. To every one he soon became "Uncle Jimmie," the beloved.

As a colleague and superior officer his consideration and gentleness were again the most conspicuous characteristics. His judgment was good, but his personal advice and example were more precious. He was willing to undertake more than his share. As his age mounted and there came a time when it seemed unwise to let him carry so many burdens, one of the problems all of us had to face was how to lighten the load without making him feel that he was not doing his full duty. For many years it has been one of my own responsibilities to stand between Professor Kemp and many of the drains upon his time and energy. Although he fully understood the plan, it was characteristic of him to worry more about the overload on other people and the danger to them rather than about himself.

His administration was characterized by the same spirit. He would not overurge his own claims and could always see the needs of others. He seemed to feel that he "could get along for this time" if some one else were to benefit by the self-denial. It was always a great trial to him when disagreeable tasks of discipline had to be performed, as sometimes happens in administrative work, and they were always avoided if any other course were possible. An occasional trying experience of this kind made great inroad on his physical resources and caused him more distress than any other of his numerous and exacting tasks.

Professor Kemp was called upon for help in a thousand ways. He was always in demand as a speaker, as a mixer, as a member of committees and of commissions and delegations of all kinds. His clever wit and elegant form of expression and ready tact made him particularly acceptable as a speaker on many important occasions. He was most happy at functions where good fellowship and good feeling were to be cultivated. In late years it had been physically impossible for him to meet all demands of this kind. Yet he could hardly bring himself to say "no," and perhaps it was due to these exhausting tests of his strength, more than to any other single thing, that his breakdown of eleven years ago is to be charged. For four years then his regular activities were broken, but the loyalty of his friends and the rejuvenating power of a great will "to get back into the harness" again, as he was wont to call it, finally won out, and he came back to his old activities to continue them even to the very day of his death.

Many organizations looked to him for counsel and gave him their highest honors. Perhaps it is sufficient to recall that the American Institute of Mining and Metallurgical Engineers, the Mining and Metallurgical Society, the Geological Society of America, and the Society of Economic Geologists have been glad to honor him, not only with the presidency of their organizations, but also for almost a generation have included him in their important councils, and have looked to him to help formulate and maintain their policies.

Professor Kemp was one of the most widely known of American geologists. He was a familiar figure in international congresses. His scientific ability and geological bent showed early and were so marked at the time of taking work under the veteran Professor John S. Newberry, founder of the Department of Geology at Columbia, that he was soon singled out for special favor and later became his personal assistant and choice as a successor. So his geologic career began as it also ended, following in the footsteps of a giant of the early days. The careers of these two men span the whole history of geology in Columbia; and most of its growth, from the time when a single instructor and a handful of students constituted the entire establishment, to the present day, with several hundred students and a staff of ten, has come within the lifetime of Professor Kemp. His own fame as a leader in the science of geology is responsible for much of this growth.

In his scientific work his insistence on simplicity, his avoidance of speculation, and his genius for application in a field not until recently recognized as an applied science, surpassed his other qualities. He was as true to his scientific convictions as he always was to his friends. He had a peculiar competence in interpretation. His engineering training gave him a background quite different from that of most men of his science. This, coupled with his practical mind, made him an important influence in the field of mining geology, where his writing and advisory services have contributed greatly toward a better standing for geologists.

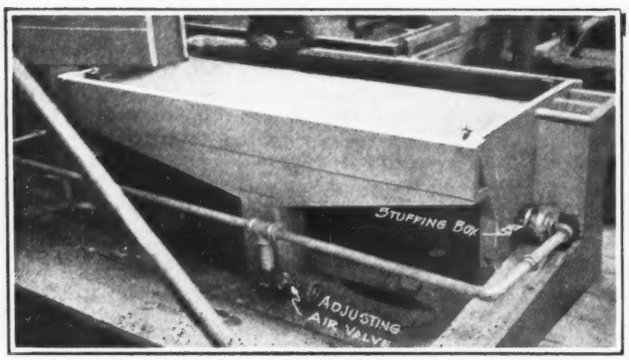
Those who know the history of geological thought in the last quarter of a century will recall that he has stood steadfastly in defense of principles and ideas that he believed were of greatest importance in his own field of investigation. As a student of ore deposits none has surpassed him in zeal or understanding. One of the finest tributes that can be paid to his scientific work is that it has proven to be sound. It was never spectacular or speculative, but always calculated to a better practical understanding. His advice was sought in many important enterprises. The sincerity of the man, the absolute certainty that he would do his best, and the conviction, in cases of contest, that his findings were to him the absolute truth, were always of great value. There was never any doubt, even in the minds of opponents, about his sincerity or his fairness. This, coupled with his broad experience and extensive knowledge, left little to be desired.

Not often could he be brought into controversy. Occasionally, however, he felt obliged to take opposite views from some of his contemporaries. Under such circumstances, he was particularly considerate. He never took advantage by under-statement of their position, and he never stooped to abuse or belittling comment. He sometimes took evident pride in formulating a more intelligible statement of his opponent's position than he himself had made. More than once he has explained to me that one's case is never strengthened by such methods, which "only raise a feeling of bitterness and a sense of injustice." It is a great advantage if one can convince even his opponents that they have been fairly dealt with.

Professor Kemp was, after all, a many-sided man. He was a man of firm faith as well as kindly deeds; a man of science who had not forgotten the religion of his youth; a man of broad culture who was at the same time as simple wonder-minded as a child. His presence always created an atmosphere that was helpful. For so many years this influence has pervaded the work of his department at Columbia, that gentleness has become a tradition. Those of us who know these things look on his passing with alarm. His work will go on, but his place can never be filled. His name also will soon become a tradition, one, I am sure, that will be helpful because of the things that are embodied in it. No institution can fail to reap lasting benefit from the service of such a man, and it is a fitting reward that he should be crowned with so full measure of loyalty and devotion.

CHARLES P. BERKEY.

New Machinery and Inventions



Flotation machine as it appears installed

An Improvement in Pneumatic Flotation

With the introduction of considerable quantity of lime in the flotation feed, as a means of raising the grade of the concentrates by depressing the iron, difficulties have arisen with the flat stationary blanket common to the Callow type of pneumatic cell, by reason of the deposition of lime in the blankets, which thereby increases the resistance of the blankets to the passage of the air and increases the pressure and the power required. A new machine—the MacIntosh—has been invented to overcome these defects and does so to a remarkable degree.

The main feature of the MacIntosh cell is a revolving rotor, about 9 in. in diameter and varying in length up to 10 ft. This rotor revolves at 15 r.p.m. and is covered with two or more plys of canvas, or other suitable porous medium. Blower air at 1½ to 2½ lb. pressure is introduced into the rotor through hollow pipe trunnions, from either or both ends of the machine, the trunnions working through suitable stuffing boxes and being driven either by sprocket chain or belt from a countershaft or by worm or spur gearing from a direct-connected motor.

The accompanying cuts give a perspective view of the rotor, and show the method of securing and tightening the canvas covering; also of the machine with the rotor in place.

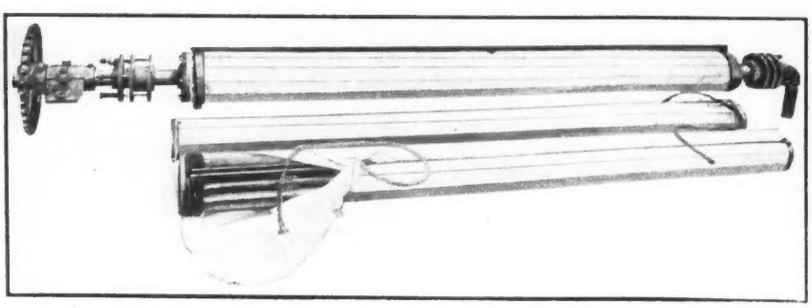
Capacity will vary with the floatability of the ore in question. The 10-ft. rotor has a surface area of 23.2 sq.ft., or 2.32 sq.ft. per foot of length. In one large plant eighteen 10-ft. rougher cells and six 10-ft. cleaner cells (double cleaning is used) are installed for the treatment of 3,000 tons of copper ore per day. This is equivalent to 557 sq.ft. of aërating surface or 5.38 tons per square foot of rougher and cleaner area. A conservative figure on average ores would be 5 tons per square foot for the necessary rougher area, the manufacturer states. Where double cleaning of the rougher frother is advisable, the ratio of cleaner to rougher area should be about 1 to 3, and for single cleaning 1 to 4 or 5.

The air pressure required will vary from a low figure of 1½ lb. to a maximum of 3 lb. per square inch. The quantity of air will vary from a minimum of 5 to a maximum of 7 cu.ft. per minute per square foot of aërating surface—or say from 12 to 16 cu.ft. per minute for each linear foot of rotor.

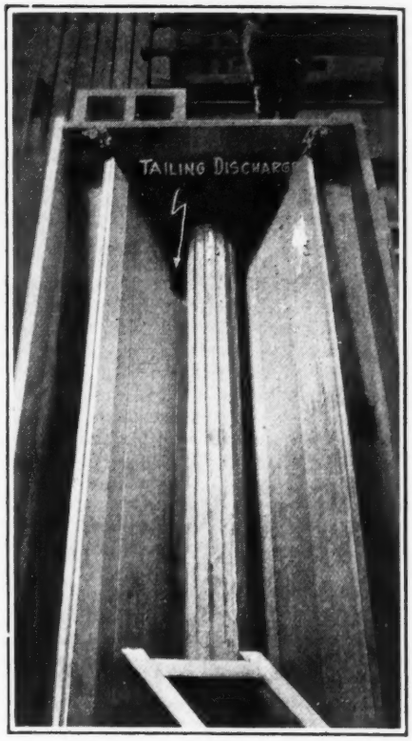
Assuming nine 10-ft. roughers and two 10-ft. cleaners (=255 sq.ft.) treating 1,000 tons per day and 7 cu.ft. of air at 3 lb. pressure for each square foot of aërating surface, the power required is 32 hp. (P. H. & F. M. Roots Co. blower data) = 768 hp. = 573 kw.-hr., or 0.573 kw.-hr. per ton. On a slower floating ore, if it is assumed that twelve 10-ft. roughers and three 10-ft. cleaners (348 sq.ft.) would be needed, the power required is 42 hp. = 1,008 hp.-hr. = 752 kw.-hr.,or 0.75 kw.-hr. per ton.

In addition to the saving in power, actual operation has shown a saving of 1.5c. per ton for blanket renewals and labor, and other incidental economies. The combined saving in power, renewals and labor (with power at 1c. per kw.hr.) can safely be assumed to be about 4c. per ton of ore treated.

For the same tonnage, the floor space occupied by the MacIntosh cell is about 55 per cent of that required for the standard Callow cell, with only one-eighth the number of air connections. A 10-ft. MacIntosh cell has an over-all dimension of 5x14 ft. and a single air connection.



Rotor removed from machine, showing how the canvas covering is secured and tightened



Flotation machine showing rotor in place

Catalogs

Circuit Breaker Switch—The Ohio Brass Co., Mansfield, Ohio, in booklet No. 50, describes a mine circuit-breaker switch recently developed by the company.

Waste Heat Generator — The La Mont waste heat steam generator is fully described in a 16-page booklet issued by the La Mont Corporation, 200 Fifth Avenue, New York. This generator is intended for carburetted water gas, blue gas, producer gas, and oil gas. The company's Duplex steam sealed valve is also described.

Drill Sharpener—Bulletin 72-J, Sullivan Machinery Co., Chicago, Ill., covers the Sullivan drill sharpener, in its latest type intended for heavy duty.

Tables — The latest improved Overstrom Universal concentrating table is described in a bulletin of the Straub Manufacturing Co., Inc., 507 Chestnut St., Oakland. The Straub company is the exclusive manufacturer of this machine.

Filters—The Oliver Continuous Filter Co., San Francisco, Calif., has just issued Bulletin No. 20, fully describing the operating principles and construction details of drum filters in their many types which the company manufactures. It covers among others the double-drum filter, which has been designed to meet the demand from selective flotation plants producing two kinds of concentrate.

Market and Financial News

Kennecott on $5 Dividend Basis

Current Earnings More Than Adequate—Third-Quarter Operations of Utah and Nevada Consolidated Show Increased Earnings

SHAREHOLDERS of the Kennecott Copper Corporation on Jan. 2 will receive $1.25 instead of the $1 quarterly dividend prevailing heretofore. There is every reason to believe that this rate will be maintained; indeed, still further increases would not surprise Wall Street.

Today Kennecott has outstanding 4,474,883 shares, making dividend requirements at the new rate $22,374,415. The accompanying estimates, Table I, show the approximate earnings of the various properties controlled by Kennecott, based on the prorated shareholdings in each, and the current rates of production and costs. Assuming that copper remains at between 13½ and 14c. per pound the earnings should be considerably more than enough to pay dividends.

Moreover, Kennecott can increase output materially at Utah and at each of the Nevada Consolidated properties —Nevada, Ray, and Chino—without any important additions to the present plant, including mining, milling, smelting, and transportation. The gross potential production of the entire group is probably not less than 825,000,000 lb. per year.

For practical purposes, Braden is owned entirely by Kennecott, which owns also more than 95 per cent of Utah and more than 40 per cent of Mother Lode Coalition. Before the absorption of Ray and Chino by Nevada Consolidated, Kennecott, through Utah, owned slightly more than half of 2,000,000 outstanding shares of Nevada. When the consolidation was effected 5,000,000 shares of Nevada Consolidated were authorized, and the latest published report shows 3,427,867 shares outstanding. It is understood that either Utah or Kennecott has acquired a large holding in addition to the original block owned by Utah.

At the time of the merger $45,000,000 in convertible debentures were issued by Nevada Consolidated. The portion of these now outstanding represents the only indebtedness of any of the Kennecott group. During the last eighteen months about $10,000,000 in notes representing the balance of Braden's debt have been retired, thereby clearing the decks for the recent action in increasing the dividend.

The current reports of Utah and Nevada Consolidated for the third quarter, just issued, throw some light on the excellent position of the holding company. Utah produced 61,804,076 lb. of copper, an increase of about 8,000,000 lb. over the average of the quarters of the last two years.

The average grade of 3,542,900 tons of ore treated at the mills was 1.03 per cent copper and the average mill recovery of copper in the form of concentrates was 88.24 per cent of that contained in the ore, as compared with 0.99 per cent copper and 87.92 per cent recovery, respectively, for the previous quarter. The average net cost per pound of copper produced, including depreciation of plant and equipment and all fixed and general expenses and after crediting gold, silver and miscellaneous earnings, was 7.8c., as compared with 8.5c. for the preceding quarter, computed on the same basis.

Nevada Consolidated likewise increased its production rate from about 55,000,000 lb. per quarter to slightly more than 58,000,000 lb. Concentrating ore shipped totaled 2,686,989 tons of an average grade of 1.283 per cent.

The average recovery in the form of concentrates from all company material milled during the period was 86.02 per cent of the total copper contained therein, corresponding to 22.07 lb. of copper per ton treated, as compared to a recovery of 85.79 per cent and 20.71 lb. per ton for the previous quarter. The net cost per pound of copper produced, after crediting revenue from gold and silver and other miscellaneous earnings and income from subsidiaries, was 9.87c., as compared with 9.91c. for the second quarter. These costs include all operating and general charges of every kind except depreciation and reserve for Federal taxes.

Kennecott has paid dividends in every year since organization except in 1921 and 1922. The stock ranged between 34 and 57¾ in 1924 and between 46 and 59 in 1925, yielding a return at the average of the high and low prices of about 6½ per cent in 1924 and 5.75 per cent last year. The yield at the current price is close to 8 per cent.

Table I—Estimated Earnings of Kennecott Copper Corporation

Property	Kennecott Proportion Current Output, Pounds per Year	Estimated Cost Including Depreciation and Taxes—Cents per Pound	Estimated Profit at 14c. Copper		Estimated Profit at 13½c. Copper	
			Cents Per Pound	Total	Cents Per Pound	Total
Utah	250,000,000	7.75	6.25	$15,625,000	5.75	$14,375,000
Braden	180,000,000	7.50	6.50	11,700,000	6.00	10,800,000
Nevada	70,000,000	10.00	4.00	2,800,000	3.50	2,450,000
Alaska	35,000,000	9.00	5.00	1,750,000	4.50	1,575,000
Mother Lode	8,000,000	7.50	6.50	520,000	6.00	480,000
Totals	543,000,000			$32,395,000		29,680,000

Table II—Utah Copper Financial Results

1926, Quarter	Third	Second	First
Net profit from copper production	$3,376,771.69	$2,516,372.97	$2,519,419.48
Miscellaneous income, including gold and silver	789,827.52	593,277.49	589,014.34
Bingham & Garfield Railway dividend	75,000.00	75,000.00	75,000.00
Nevada Consolidated Copper dividend	250,125.00	250,125.00	250,125.00
Income, miscellaneous securities	53,954.25	161,862.75	.....
Total income	$4,545,678.46	$3,596,638.21	$3,433,558.82
Depreciation	312,256.78	299,801.85	303,701.16
To surplus	$4,233,421.68	$3,296,836.36	$3,129,857.66

Silver production from domestic sources in October was 5,011,000 oz., against 4,860,000 in September. The foreign output was 6,763,000 oz., against 6,602,000 in September. Production for the ten months this year totaled 111,106,000 oz. of which 50,421,000 were domestic.

Table III—Nevada Consolidated Financial Results

1926, Quarter	Third	Second	First
Operating profit from copper production	$1,967,384.14	$1,711,797.80	$1,882,956.77
Value of precious metals	219,373.75	212,044.90	204,880.49
Miscellaneous revenues, including income from subsidiaries	244,757.74	209,050.64	187,273.50
Total operating income	$2,431,515.63	$2,132,893.34	$2,275,110.76
Depreciation	412,662.42	412,771.96	412,662.42
Net income	$2,018,853.21	$1,720,121.38	$1,862,448.34

Technical Position of Zinc Is Sound

By A. J. M. Sharpe
Honorary Foreign Correspondent of the American Zinc Institute

London, Nov. 1, 1926—With Christmas comparatively close at hand, it is safe to say that, unless the coal strike is settled within the next fortnight, there can be little in the way of a resumption of zinc smelting in Great Britain before the first of January, as it will be at least a month after the ending of the coal dispute before smelting operations can really get under way.

Consumption of slab zinc in Great Britain is holding up remarkably well in the circumstances, especially as, following the first paralyzing effects of the closing down of the coal mines and steel works, consumers had necessarily to import both of these commodities. In the last three months the United Kingdom has consumed just over 12,000 tons of zinc monthly, and it must be remembered that every ton of this has had to be imported.

On the Continent the zinc rollers continue fully occupied, but there is not the amount of new business there was on hand a month ago, and the time for delivery has now been reduced to six or eight weeks, in contrast with three months.

The Belgian metal output is fully maintained and the same may be said of smelting in Germany, Poland, and France. Whether the present slowing down of trade in the fabricating end is of a permanent or a purely temporary nature, it is impossible to judge at the moment, but the position in this respect will be clearer two months hence. We may attribute some of the falling away to seasonal causes, as the building trade is less active than in the summer months and there is consequently not the same home demand for rolled zinc, galvanized sheets, and oxide.

I estimate world stocks of zinc on Nov. 1 to be as follows:

	Metric Tons
United States	14,400
Canada	2,300
Australia (including unsold shipments afloat)	2,200
Germany and Poland	6,000
Belgium	2,400
France	1,000
Great Britain	1,000
Scandinavia	200
Far East	500
Elsewhere	1,500
Total	31,500

The market has suffered in sympathy with the easier tendency of other nonferrous metals, and zinc has, moreover, been affected by the decline in the St. Louis quotation and the somewhat freer offerings in London by Belgium and Germany. On the other hand, it is not anticipated that this larger selling on the London market will result in any marked increase in declarations: probably a high percentage is represented by selling by Continental smelters against ore purchases.

Admittedly, there is little to warrant the belief of any substantial improvement in the zinc market yet awhile—apart from any sentimental rally when the settlement of the coal strike is announced—but, generally, the technical position is sound and unless there be unfavorable developments of an extraneous character, we may reasonably expect a brighter zinc market before long.

Statistical Notes

Zinc production from countries which in 1925 furnished 97 per cent of the world's total is estimated by the American Bureau of Metal Statistics at 114,005 tons for October, compared with 107,673 tons in September. The rate is not as high, however, as that of April, 1926, when 112,653 tons was produced in a 30-day month.

Asbestos production from Rhodesian mines in July totaled 3,340 tons, valued at £80,979, and the Union of South Africa produced 839 tons, valued at £10,887. Exports from Canada totaled 13,220 tons, with a value of $796,586.

Union Minière Copper production in October was 13,400,000 lb., compared with 15,200,000 lb. in September. The Katanga "copper giant," with the exception of February, has produced less during each month in 1926 than in the corresponding month of 1925.

The Utah-Apex Mining Co., for the year ended Aug. 31, 1926, shows profit of $781,986, after depreciation but before depletion and federal taxes, against a profit of $1,054,762 in previous year. Current assets as of Aug. 31, 1926, totaled $1,285,134, and current liabilities $239,892, comparing with $1,601,199 and $17,908, respectively, in preceding year.

Sulphur shipments through Galveston, Texas City, and Freeport, for the twelve months ended Sept. 30, totaled 1,214,513 tons. This is an increase of 281,225 tons over the corresponding twelve months of 1925. Of the total movement, 451,783 tons was exported to foreign countries. Official government reports for the fiscal year ended June 30, 1926, showed 408,971 tons, valued at $7,588,713, exports from three ports.

Texas Gulf Sulphur Co. has declared an initial dividend of $1 on the new no-par stock, payable Dec. 15 to stock of record Dec. 1. This places the stock on a basis equivalent to $16 annually on old $10 par stock, recently split four for one. Three months ago a quarterly dividend of $3 was declared on the old stock.

Copper production for October, in countries that in 1925 accounted for 97 per cent of the world's output, was 137,659 tons, according to the estimate of the American Bureau of Metal Statistics. This compares with 132,013 tons in September and approximates the high level of last April. The increases are in the United States, Peru, and Chile. Declines are reported from Europe and the Belgian Congo.

Dome Mines production in October was valued at $324,629, against $324,774 in September, $32,243 in August, and $370,005 in October, 1925.

A. S. & R., New Cornelia, and Miami Increase Dividends

The following dividends were paid by American mining and metallurgical companies in September:

Companies in the United States	Situation	Per Share		Total
American Smg. & Ref.	Various	$2.00	Q	$1,219,960
Anaconda Copper	Various	0.75	Q	2,250,000
Betty O'Neil, s	Nev.	0.05	Q	23,273
Chief Consolidated, l, s	Nev.	0.10	Q	114,156
Colo. Fuel & Iron pfd.	Various	2.00	Q	40,000
General Development, h	Various	0.25	Q	30,000
Gladstone Mountain, l	Wash.	0.005	M	6,609
Homestake Mining, gS. D.		0.50	M	125,580
Internat. Nickel pfd., n, c	Various	1.50	Q	133,689
Iron Cap Copper pfd.	Ariz.	0.15	Q	2,645
Miami Copper	Ariz.	0.375	Q	280,168
New Cornelia Copper	Ariz.	0.50	Q	900,000
New Jersey Zinc	Various	2.00	Q	981,632
Sidney Mining, z,l,s.	Idaho	0.005	I	7,500
Union Copper L. & M., h	Mich.	0.25	A	20,000
U. S. Steel pfd.	Various	1.75	Q	6,304,919
United Verde Ext., c.	Ariz.	0.75	Q	787,500
Vanadium Corp.	Various	0.75	Q	283,775
Companies in other countries				
Amaparo Mining, g,s	Jalisco	0.02	Q	40,000
Aramayo, s,t,b,c	Bolivia Sw. fr.	1.25		1,050,000
Cerro de Pasco, c,s.	Peru	$1.00	Q	$1,122,842
Hollinger Con. Gold.	Ont.	0.10	F	492,000
Lucky Tiger-Comb., g,s	Sonora	0.07	M	50,074
Total				$15,216,322

l, lead; s, silver; h, holding company; g, gold; n, nickel; c, copper; z, zinc; t, tin; b, bismuth; Q, quarterly; M, monthly; I, irregularly; A, annually; F, every four weeks.

Three companies increased their dividends in the November distributions to stockholders. The American Smelting & Refining Co. is now on an $8 a year basis, compared with $7 previously; Miami Copper reflected the unusually low costs now being secured in treating its low-grade ore, by increasing the quarterly rate from 25 to 37½c.; and New Cornelia paid 50c. per share, compared with 40c. in August and May, 30c. in February, and 25c. a year ago. It is noteworthy that these dividends have been raised in the face of gradually declining copper prices, indicating that modern methods of treatment are reducing costs of production.

Dividend Yields

The dividend yields on the stocks of the above companies that are on a regular dividend basis, based on the November distribution except as noted, and on recent market prices, are as follows:

Company	Per Cent Annual Yield
Gladstone Mountain(a)	23.3
Chief Consolidated	15.1
United Verde Extension	12.1
Lucky Tiger-Combination	11.8
Homestake (a)	11.4
New Cornelia Copper	9.1
Miami Copper	9.0
Vanadium Corporation	7.3
Colo. Fuel & Iron pfd.	7.2
Hollinger Gold	7.0
Cerro de Pasco Copper	6.4
New Jersey Zinc (a)	6.3
Anaconda Copper	6.2
American Smelting & Ref.	6.0
International Nickel pfd.	5.8
U. S. Steel pfd.	5.4
Average	9.3

(a) Based on dividends for last twleve months.

The average yield is somewhat higher than for the same stocks in August, owing to increased dividends by some of the companies and to declines in the stock market value of securities in some instances.

The Market Report

Lead and Tin Firm; Copper, Silver, Zinc, Weaker

Metal Markets Somewhat More Active Than Last Week—Copper Price Trend Still Downward

New York, Nov. 24, 1926—The brightest feature of the non-ferrous metal markets in the week ending today has been the continued excellent demand for lead, which seems very firm indeed at current levels. Tin is extremely scarce and spot Straits has sold at the highest price in seven years, though forward deliveries can be had for 4 or 5c. less. Copper prices have receded throughout the week, the concessions having attracted a reasonable amount of purchasing. Zinc has been dull at somewhat lower prices, and the same may be said for silver. London prices are substantially the same as a week ago.

Copper at 13.70c. Delivered

Last Thursday, some sellers were still able to get 13¾c. for copper for Connecticut deliveries and 14c. in the Middle West, though much of the business on that day was placed at 13⅞c., delivered Connecticut. In the next two or three days, practically all of the business was done at 13¾c. in the East and at concessions from the 14c. level in the Middle West. Yesterday, still lower prices were quoted on some attractive business, and the largest tonnage of the week was sold at 13.70@13.75c., for Valley deliveries. The same prices are being quoted today, one order being booked as low as 13.675c. The total volume for the week is more than twice what it was last week, and the market may be said to have been reasonably active. The deliveries have been pretty well divided between December and January, with some scattering orders for prompt and February; all have sold at the same price.

The recession in copper prices has caused the American Brass Co. to reduce prices on its products by ¼c. per lb., effective today. Export prices on copper are now 14.125c., c.i.f.

Lead Prices Unchanged

Lead prices have been remarkably uniform throughout the week, at 8c. New York, 7.90c. Chicago, and 7.80c. St. Louis. Most all of the sellers have done an excellent business, and no pessimism seems to be in evidence regarding the immediate future. Most of the business continues to be for prompt and December shipment, though three or four orders for January have been placed. Practically every class of buyer has entered the market for good tonnages. Some dealers are disposed to quote slight premiums in both the New York and St. Louis markets for prompt shipment, but they have done little or nothing above the levels mentioned above. The American Smelting & Refining Co. official quotation continues at 8c., New York.

Zinc Inquiries Light

But little interest has been taken in the zinc market this week, and galvanizers report their business falling away somewhat. Prices for the last two or three days have been at the lowest levels since last June, though there has been no great pressure to sell. Offerings have been made as low as 7.15c., St. Louis, without tempting buyers. Prompt shipment continues to be quoted at slight premiums. High-Grade is offered at 9c., delivered in the East, but in this, and in Brass Special also, there is little interest.

Spot Tin at 72½c.

The squeeze on spot Straits tin continues, both here and in London, and at 72½c. yesterday the price was the highest reached since 1919. February shipment can be obtained at about 4½c. less than spot, and intermediate deliveries also sell at substantial concessions. Some of those who have been holding all their supplies for spot sales are releasing metal for December delivery, indicating less confidence in the spot market at the end of the year. The prices for 99 per cent grades, for prompt deliveries, are largely nominal.

Silver Quiet

Chinese buying advanced prices on Nov. 18, to the highest level since Oct. 13, the quotation being 55⅜c. as compared with 56⅛c. on the former date. At this point India dropped out of the market, and on the following day Lon-

Daily Prices of Metals

Nov.	Copper N. Y. net refinery	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
18	13.575	69.375	70.50	8.00	7.80	7.175–7.225
19	13.55	69.00	70.25	8.00	7.80	7.15@7.20
20	13.55	69.75	71.00	8.00	7.80	7.15@7.20
22	13.525	69.625	71.75	8.00	7.80	7.15@7.20
23	13.475	70.00	72.375	8.00	7.80	7.15@7.20
24	13.475	68.875	71.50	8.00	7.80	7.15@7.20
Av.	13.525	69.438	71.229	8.000	7.800	7.179

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Nov.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
18	57⅛	58	65½	314¼	301¼	29⅛	29½	33 7/16	33 7/16
19	57	57⅞	65½	309	298	28⅞	29 5/16	33⅛	33 3/16
22	57	57⅞	65¼	312	300½	29	29⅜	33 5/16	33 5/16
23	57	57⅞	65	316½	302½	29⅜	29 11/16	33 11/16	33 11/16
24	56⅞	57⅝	65	313	300	29 3/16	29 9/16	33½	33½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Nov.	Sterling Exchange "Checks"	Silver		Gold London	Nov.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
18	4 84½	55¾	25⅞	84s11½d	22	4 84⅜	54⅝	25⅜	84s11½d
19	4 84¼	54⅜	25⅜	84s11½d	23	4 84⅜	54½	25⅜	84s10d
20	4 84⅜	53¾	25 3/16	....	24	4 84⅜	54	25⅛	84s11d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

don reported China and the bazaars as sellers, with a consequent drop overnight of ¼d. in London and 1⅝c. in New York. A further decline occurred on the 20th, but at this lower level India resumed purchases, which caused some recovery. However, as prices advanced, India again lost interest, with a consequent easing off of rates, and the market closes quiet with no keenness shown by either buyers or sellers.

Mexican Dollars (Old Mexican pesos) Nov. 18th, 42¼c.; 19th, 41⅝c.; 20th, 40⅝c.; 22d, 41⅝c.; 23d, 41½c.; 24th, 41c.

Exchanges Quiet

The foreign exchanges have been generally quiet; francs are somewhat higher than a week ago, but have declined from their high point. Closing cable quotations on Tuesday, Nov. 23, were as follows: francs, 3.49c.; lire, 4.19c.; and marks, 23.74c. Canadian dollars, $\frac{3}{16}$ per cent premium.

Other Metals

Quotations cover large wholesale lots unless otherwise specified. London prices are according to latest mail advices.

Aluminum—Both 98 and 99 per cent grades quoted at 27c. per lb. London, £107 per long ton for domestic metal.

Antimony—Per lb., duty paid, New York: Chinese brands, spot, 13@14⅛c.; January 14@14⅛c. Cookson's "C" grade, 17½c. Needle and oxide nominally unchanged from quotations in the Nov. 6 issue.

Bismuth—Per lb., New York, in ton lots, $2.70@$2.75. London, 10s.

Cadmium—Per lb., New York, 60c. London, 1s. 10½d.@1s. 11d. for American metal; 1s. 9d. for Australian metal.

Iridium—Per oz., $120@$125 for 98 @99 per cent sponge and powder. Firm. London, £32½ in iridio-platinum; £18@ £22 for sponge and powder. Nominal.

Nickel — Per lb., ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade). London, £170@£175 per long ton according to quantity.

Osmium—Per oz., $55@$60. London, £16@£19.

Palladium—Per oz., $66@$70. Pure metal as a constituent of crude platinum, $55@$60 per oz. London £11@ £13, nominal.

Platinum — Official price on refined metal, $112 per oz. Open market cash sales of large lots, $107. Pure metal as a constituent of crude platinum, $105. Market dull.

London, £23 per oz. for refined and £20½ for crude. Dull.

Quicksilver—Per 75-lb. flask, $99. San Francisco wires $98.67, steady. London, £16½.

Ruthenium—Per oz., nominally $45@ $50. London, £7½@£11.

The prices of **Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Radium, Rhodium, Selenium, Tantalum, Tellurium, Thallium, Tungsten**, and **Zirconium** are unchanged from the issue of Nov. 6.

Metallic Ores

Manganese Ore—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn, 32@34c. Caucasian (washed), 53@55 per cent, 38@ 40c. The market is firmer on account of smaller imports.

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian and Cuban, $70@$80 per ton in carloads.

Tungsten Ore — Per unit of WO_3, N. Y.: Wolframite, $10.50@$10.75; Western scheelite, $11@$11.25. Dull.

Chrome, Iron, Molybdenum, Tantalum, Uranium, and **Vanadium Ores** are unchanged from quotations in the Nov. 6 issue.

Zinc Blende and Lead Ore Prices Unchanged

Joplin, Mo., Nov. 20, 1926

Zinc Blende

High		$51.85
Premium blende, basis 60 per cent zinc	48.00@	49.00
Prime Western, basis 60 per cent zinc		47.00
Fines and slimes, 60 per cent zinc	46.00@	44.00
Average settling price, all zinc		47.55

Galena

High	$105.00
Basis 80 per cent lead	100.00
Average settling price, all lead	103.19

Shipments for the week: Blende, 18,299; calamine, 61; lead, 2,580 tons. Value, all ores the week, $1,138,390.

The purchase today was the equivalent of 18,700 tons of zinc concentrates. The production was 1,000 tons less. Shipments are close to the purchases. The unsold stock has been reduced to the lowest point in many months, and a considerable restriction of output is probable next week, over the Thanksgiving period.

An increased tonnage of lead concentrates was moved this week, and it is claimed by some sellers that their ore brought a premium over the current quotation.

Platteville, Wis., Nov. 20, 1926

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$49.75
Lead Ore	
Lead, basis 80 per cent lead	$100.00

Shipments for the week: Blende, 1,277 tons; lead, none. Shipments for the year: Blende, 50,530; lead 1,726 tons. Shipments for the week to separating plants, 1,876 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fuller's Earth, Fluorspar, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystals, Silica, Spodumene, Sulphur, Talc, Tripoli, and **Zircon** are unchanged from prices in the Nov. 6 issue.

Mineral Products

Arsenious Oxide (White Arsenic)— 3½c. per lb. Sales improved this week; largely to calcium arsenate manufacturers. London, £16 per long ton.

Calcium Molybdate, Copper Sulphate, Sodium Nitrate, Sodium Sulphate (Salt Cake), and **Zinc Oxide** are unchanged from prices in the Nov. 6 issue.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $100 per long ton, furnace, for delivery during first half of 1927. Imported alloy, $100, duty paid. Market active. Spiegeleisen, 19@21 per cent, $38@$40 f.o.b. furnace; 16@19 per cent, $32@$34. Advance due to higher coke prices.

Ferrocerium, Ferrochrome, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and **Ferrovanadium** are unchanged from prices in the Nov. 6 issue.

Metal Products

Rolled Copper—Sheets, 22c.; wire, 16c.; f.o.b. mil.

Lead Sheets—Full rolled, per lb., 11⅞c.; clipped, 12c.

Nickel Silver—29c. per lb. for 18 per cent nickel Grade A sheets.

Yellow (Muntz) Metal—Dimension sheets, 19⅝c. per lb.; rods, 16⅝c. per lb.

Zinc Sheets—11¾c. per lb., f.o.b. mill.

Refractories

Fireclay Brick, Chrome Brick, Magnesite Brick, Silica Brick and **Zirkite** are unchanged from quotations in the Nov. 6 issue.

Steel, Pig Iron, and Coke Inactive

Pittsburgh, Nov. 23, 1926

Steel-mill operations have slowed down a trifle from the October rate, which was by a small margin the highest rate since April. The sag is inconsequential, being less than might be expected considering the time of year, with all buyers committed to a very conservative policy.

Both estimates made in the automobile trade as to this month's production of trucks and passenger automobiles, and knowledge of shipments of steel made to the automobile trade, prove that the recently reported slowing down in the automobile industry was exaggerated. There has been no more than what should be considered a seasonal decrease. As to the recent quiet period in the agricultural-implement trade, reports now are that operations will increase after Jan. 1.

All precedents indicate that steel production will begin trending upward after Jan. 1.

Finished-steel prices show some slight unsteadiness at a few spots. There is a trifle more shading in sheets, and carloads of merchant bars now go more commonly at 2.00c., whereas for awhile 2.10c. was the regular carload price.

Pig Iron—What little interest there was in pig-iron purchases largely disappeared when news came that the British coal strike was about to be ended. The Valley market remains dull and steady at $20 for bessemer, $18.50 for basic, and $19@$20 for foundry, f.o.b. Valley furnaces.

Connellsville Coke — Demand has been very light, and offerings likewise. Prices are off a trifle, at $4.50@$4.75 for spot furnace and $5.50@$6 for spot foundry.

Current Prices of Mining Supplies

Rise and Fall of the Market

DECLINES exceed advances by a small margin, when current prices are compared with those of a month ago. Fire, air and steam hose, linseed oil and litharge are all below October levels, while angle bars, track bolts and cut nails appear higher. Price fluctuations occurred in heavy mine timbers but without developing any definite upward or downward tendency.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.40	$3.60	$3.50	$3.90	$3.89
Black					
No. 24	3.10	4.45	3.95	4.90	4.35
Galvanized					
No. 24	3.95	5.25	4.80	5.65	5.10

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00
Standard openhearth rails	43.00	43.00	43.00	43.00

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.80–2.90	$2.80	$3.55	$3.65	$3.80	$3.00
Track bolts	3.90–4.25	3.90@4.15	4.55	4.60	5.35	3.90
Standard section angle bars	2.85@2.95	2.75	3.40	3.75	3.60	4.15

STRUCTURAL MATERIAL—Following are base prices in carload lots, f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. in less than carload lots, from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.00	$2.05	$3.34	$4.15	$3.25	$3.10	$3.30
Channel, 3 to 15 in.	2.00	2.10	3.34	4.15	3.25	3.10	3.30
Angles, 3 to 6 in., ¼ in. thick	2.00	2.10	3.34	4.15	3.25	3.10	3.30
Tees, 3 in. and larger	2.00	2.10	3.34	4.15	3.35	3.10	3.30
Plates ¼-inch thick	2.00	2.00	3.34	4.15	3.25	3.10	3.30

WIRE ROPE—Discounts from list price, f.o.b. New York and east of Missouri River, on regular grades of bright and galvanized are as follows:

Cast steel round strand rope	20%
Galvanized steel rigging and guy rope	7½%
Round strand iron and iron tiller	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Galvanized iron rigging and guy rope	+12½%

	New York	Cleveland	Chicago
Drill Rod (from list)	60%	55%	50%

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

	Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
BUTT WELD	½ to 3	62	50½	¼ to 1¼	30	12
LAP WELD	2½ to 6	59	47½	3 to 6	28	13

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
2½ to 6 in. lap welded	48%	51%	46%

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
6 in. and over	$51.60@52.60	$50.60@51.60	$40.00 base	$48.20	$45.60	$50.00

NUTS—Semi-finished, ½x¼-in., 2c. each. Discount 70% for ⅝-in. and smaller; 65% for ¾-in. and larger. Case hardened, 6c. each, less 50%.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Current on Trucks	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0.1027	$0.1027	$0.088	$0.105	$0.0685	$0.108	...
8x12x12	.1541	.1541	.119	.....	.09	.156	$0.252*
6x12x12	.1926	.1926	.165	.205	.126	.244	.312†

* 10x12x12; † 12x12x12.

MACHINE BOLTS—½x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%.

LUMBER—Prices of rough Douglas Fir No. 1 common, in carload lots to contractors at yards in San Francisco.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft
3x3 and 4	$26.00	$27.00	$28.00	$31.00
3x6 and 8	26.00	27.00	28.00	31.00
4x4-6 and 8	26.00	27.00	28.00	31.00

Wholesale prices to dealers of long leaf yellow pine. To contractors in New York City, delivered from lighters or cars to job, $5 additional.

	New York 20 Ft. and Under	New York 22-24 Ft.	Chicago Up to 20 Ft., Pine	Chicago Up to 32 Ft., Fir
3x4 to 8x8	$43.00	$44.00	$42.25	$40.50
3x10 to 10x10	50.00	51.00	47.00	40.50
3x12 to 12x12	57.00	58.00	57.00	40.50

Other Cities	8 x 8-In. x 20 Ft. and Under Pine	Fir*	Hemlock	Spruce	12 x 12-In. 20 Ft. and Under Pine	Fir*
Boston	$49.00	$48.00†	$50.00	$51.00	$60.00	$58.00†
Cincinnati	37.00	73.00	73.00	85.00	48.00	77.00
Denver	.....	36.25	34.75	34.75	....	34.75
Minneapolis	42.50	38.75	34.50	.....	45.00	38.75
Kansas City, Mo.	42.50	42.75	.....	....	57.50	42.75
Philadelphia	54.00	38.00	38.00	45.00	65.00	38.00

*Douglas fir. † Prime.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.65	$3.05	$3.75	$4.00	$2.83	$4.95
Cut	2.85	....	5.00	5.00	2.93	5.00

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
NewYork, del. by truck	$2.50@2.60	$2.50@2.60	$2.50@2.60
Chicago, f.o.b.	2.10	2.10	2.10
Cleveland, f.o.b.	2.29	2.29	2.29

LIME—Warehouse prices, New York quotes 280 lb. net; Chicago, 180 lb.:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$18.20	$11.00	$3.50	$2.10@$3.00
Chicago	20.00	18.00	....	1.50

LINSEED OIL—These prices are per gallon:

	New York Currant	New York One Year Ago	Chicago Current	Chicago One Year Ago
Raw in barrel (5 bbl. lots)	$0.86½	$1.00½	$0.84	$1.01

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry Current	Dry 1 Yr. Ago	In Oil Current	In Oil 1 Yr. Ago
Red	15.25	15.75	16.75	17.25
White	15.25	15.75	15.25	15.75

HOSE—Quotations at New York warehouses:

Fire Protection 50-Ft. Lengths
Underwriters' 2½-in. coupled, single jacket (net) ..... $0.68 per ft.

Air—Best Grade
¾-in., per ft. ..... 3 ply $0.34 4 ply $0.42

Steam—Discounts from List
First grade .... 40% Second grade ..... 40–5% Third grade 50%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. for rubber transmission belting.
Best grade ..... 50% Second grade 50–10%

LEATHER BELTING—List price, 24c. per lin.ft. per inch of width for single ply at New York warehouses:

Grade	Discount from list
Medium	40–5%
Heavy	30–10%

RAWHIDE LACING—For cut, best grade, 50%, 2nd grade, 60%. For laces in sides, best, 41c. per sq.ft.; 2nd, 37c. Semi-tanned: cut, 50%; sides, 41c. per sq.ft.

PACKING—Prices per pound:

Rubber and duck for low-pressure steam, ½ in.	$1.05
Rubber sheet	.60
Rubber sheet, wire insertion	.85

MANILA ROPE—Per lb., ¾-in. and larger, 1,200-ft. coils.

Atlanta	$0.30	New Orleans	$0.21½
New York	.23	Seattle	.24
Chicago	22½	San Francisco	.22

EXPLOSIVES—Prices per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.265	$0.2875
Minneapolis	.1917	.2123
Denver	.2025	.2275
Seattle	.165	.19
Cincinnati	.22	.245
New Orleans	.233	.26
San Francisco	.1625	.1925

FLOTATION OIL—
Pine tar, 50 gal. bbl., gross weight 500 lb., f.o.b. New York, carload lots, per gal. $0.46

CHEMICALS—

Zinc dust, 550 lb. casks, f.o.b. works, per lb.	$0.09@.10
Litharge, casks, f.o.b. works, per lb.	.11
Sodium cyanide, 220 lb. single case lots, f.o.b. works, per lb.	18@.22
Calcium carbide, in drums, f.o.b. works, per lb.	.05½@.06

Mining Stocks—Week Ended November 20, 1926

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	49½	47¾	48	Oc.16, No.22 Q	0.75
Arcadian Consol.	Boston	1	*80	*90		
Ariz. Com'l	Boston	10⅞	10	10⅛	Jy. 16, Jy. 30	0.50
Calaveras	N. Y. Curb			1¼		
Calumet & Arizona	New York	71¼	69	69	De. 3, De. 20Q	1.50
Calumet & Hecla	Boston	17	16½	16⅞	No.30, De.15	0.50
Cerro de Pasco	New York	65	62⅞	62⅞	Oc.14,No.1, Q	1.00
Chile Copper	New York	33	32⅛	32⅛	De.1,De.27, Q	0.62½
Chino	New York			25½		
Con. Coppermines	N. Y. Curb	3	2⅞	2⅞		
Copper Range	Boston	15	14⅞	14⅞	May, 1925	1.00
Crystal Copper	Boston Curb	*36	*30	*35		
East Butte	Boston	3¼	3	3	Dec., 1919	0.50
First National	Boston Curb	*14	*14	*14	Feb., 1919	0.15
Franklin	Boston			*30		
Granby Consol.	New York	34½	33⅛	33½	May, 1919	1.25
Greene-Cananea	New York	30	27	28	Nov., 1920	0.50
Hancock	Boston			*50		
Howe Sound	New York	42¼	40	40⅞	Oc 1, Oc.15 Q	1.00
Inspiration Consl.	New York	27⅝	26⅞	26⅞	Se.16, Oc 4, Q	0.50
Iron Cap	Boston Curb	3⅛	3	3⅛		
Isle Royale	Boston	12½	12	12	No. 30, De. 15	0.50
Jerome Verde Dev.	N. Y. Curb			48		
Kennecott	New York	64¼	62½	62¾	De. 3, Ja 2 Q	1.25
Lake Copper	Boston	*85	*85	*85	June, 1925	0.50
Magma Copper	New York	37⅞	36⅛	36¼	Oc.1,Oc.15,Q	0.75
Mason Valley	N. Y. Curb	2	1⅞	2		
Mass Consolidated	Boston	*20	*20	*20	Nov., 1917	1.00
Miami Copper	New York	17	16⅞	16⅞	No.1, No.15 Q	0.37½
Mohawk	Boston	43½	41	41	Oc 30, De 1 Q	2.00
Mother Lode Coa	New York	5⅛	4	4⅛	Jn. 15, Jn. 30	0.37½
Nevada Consol	New York	16¼	15⅛	15⅞	Se.17, Se.30Q	0.25
New Cornelia	Boston	23	22	22	No.5, No.22 Q	0.50
Noranda	N. Y. Curb			18⅞		
North Butte	Boston	2⅞	2⅞	2⅞	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*39	*39	*39	Se. 1, Se. 15	0.05
Old Dominion	Boston	16⅞	16¼	16¼	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†137	†134		Se.25, Oc.2 Q	1.50
Quincy	Boston	18½	18	18	Mar., 1920	1.00
Ray Consolidated	New York	16⅛	15⅞	16	Ap.20, Ap.30	0.25
Ray Hercules	N. Y. Curb			11⅝		
St. Mary's Min. Ld.	Boston	27½	27	27	Ap.17, My.18	2.00
Seneca Copper	New York	4⅛	4	4		
Shannon	Boston	*31	*31	*31	Nov., 1917	0.25
Shattuck-Denn	Boston Curb	6⅜	6¼	6⅜		
Superior & Boston	Boston	*30	*30	*30		
Tenn. C. & C.	New York	11⅞	11⅛	11⅞	No.30, De.15, Q	0.25
United Verde Ex	N. Y. Curb	25	24⅜	24⅝	Oc.16, No. 1, Q	0.75
Utah Copper	New York	115⅜	112½	112½	Se.3, Se.17 Q	1.75
Utah Metal & T	Boston	1⅛	1⅛	1⅛	Dec., 1917	0.30
Victoria	Boston	*65	*65	*65		
Walker Mining	Salt Lake	*75	*72	*72		
NICKEL-COPPER						
Internat. Nickel	New York	38⅞	36⅞	36⅝	Se.7, Se.30, Q	0.50
Internat. Nickel, pfd.	New York	103	102¾	103	Oc. 14, No.1,	1.50
LEAD						
Gladstone Mtn	Spokane	*30	*29	*30	Nov., 1926	0.005
National Lead	New York	153	153	153	De.10, De 31 Q	2.00
National Lead pfd	New York	116½	116	116	No.19,De.15 Q	1.75
St. Joseph Lead	New York	40½	39⅞	39⅞	Sept., 1926 QX	0.75
ZINC						
Am. Z. L. & S	New York	138⅞	132½	133¼	May., 1917	1.00
Am. Z. L. & S, pfd.	New York	119½	118⅛	119⅛	Nov., 1920	1.50
Butte C. & Z	New York	5⅛	4⅞	5	De.10, De.24	0.50
Butte & Superior	New York	13⅝	12½	12½	Se.15, Se.30 Q	0.50
Callahan Zn-Ld	New York	1⅞	1⅝	1⅞	Dec., 1920	0.50
Eagle-Picher	Cincinnati	29⅝	28½	28⅛	Au.14,Se.1 Q	0.40
Eagle-Picher, pfd.	Cincinnati			100	Se. 30, Oc. 5 Q	1.50
New Jersey Zn	N. Y. Curb			191	No.20, De.10 X	2.00
United Zinc	N. Y. Curb			*70		
Yellow Pine	Los Angeles	*16½	*15	*16	Dec. 1925	Q 0.04
GOLD						
Alaska Juneau	New York	1⅝	1½	1⅝		
Argonaut	Toronto	*57½	*55	*55½		
Barry-Hollinger	Toronto	*93½	*81	*84		
Carson Hill	Boston	*26	*25	*25		
Consol. W. Dome L.	Toronto	*22⅞	*21½	*22		
Cresson Consol. G.	N. Y. Curb	2 7/32	2⅛	2 7/16	Oct, 1926	0.10
Crown Reserve	Toronto	*11¼	*10½	*10½	Jan., 1917	0.05
Dome Mines	New York	10	9⅞	9⅞	Se.20,Oc.30,Q	0.50
Golden Center	N. Y. Curb	2	2	2		
Golden Cycle	Colo Spring			2	No.30, De.10 Q	0.04
Hollinger Consol.	Toronto	18.60	18 50	18 60	No.16, De.2 F	0.10
Homestake Mining	New York	61½	61⅛	61½	No.20,No.26 M	0.50
Kirkland Lake	Toronto	*77⅞	*67	*70		
Lake Shore	Toronto	14.55	14.10	14 40	De.1, De.15Q	X 0.20
McIntyre-Porcupine	New York	23¾	23¼	23¾	No.1, De.1 Q	0.25
Newray	Toronto	*40	*39	*39		
Night Hawk Pen	Toronto	*4	*3⅞	*3⅞		
Portland	N. Y. Curb			*43		
Rand Mines	New York			41½	Au.23–30Am.Sh.1	52
Teck-Hughes	Toronto	5.10	4.82	4.87	Jy. 15, Au. 2	0.05
Tom Reed	Los Angeles			2½	March, 1926	0.02
Tough-Oakes	Toronto	*59	*55	*56		
United Eastern	N. Y. Curb	*45	*43	*45	July, 1924	0.05
Vipond Cons	Toronto	1.66	1.60	1.65		
Wright-Hargreaves	Toronto	8.55	8.40	8.45	Se.15, Oc.1 QX	0.07½
Yukon-Alaska Trust	N. Y. Curb			20		
GOLD AND SILVER						
Carnegie Metals	Boston			12		
Con. Cortez	N. Y. Curb			*4		
Con. Virginia	San Francisco	*8½	*5½	*5½		
Continental Mines	N. Y. Curb			*48		
Dolores Esperanza	N. Y. Curb			*45	July, 1923	0.05
Premier Gold	N. Y. Curb	2	1⅞	2	Se.15, Oc.4 Q	0.08
Tonopah Belmont	N. Y. Curb	2⅜	2⅛	2⅜	Se.15, Oc.1	0.05
Tonopah Extension	N. Y. Curb	*30	*25	*25	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	3⅛	3⅛	3⅛	Se.30, Oc.27 SA	0.07½
Unity Gold	N. Y. Curb			*30		
West End Consol.	N. Y. Curb	*9	*9	*9	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	*45	*45	*45	June, 1918	0.02

Stock	Exch.	High	Low	Last		Last Div.
SILVER						
Alvarado	N. Y. Curb			1	Oct., 1920	0.50
Beaver Consol	Toronto	*56	*52½	*55½	May. 1920	0.03
Castle-Trethewey	Toronto	1.17	1.11	1.13		
Coniagas	Toronto	4.50	4.30	4.50	May, 1924	0.12½
Keeley	Toronto	1.60	1.57	1.59	Se 1, Se.15 SA	0.12
Kerr Lake	N. Y. Curb	*85	*75	*85	Oc.1, Oc.15 SA	0.12½
La Rose	Toronto	*6	*5½	*5½	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto			*50	Jy. 2, Jy. 15	0.05
McKinley-Dar.-Sav	Toronto	1.14	1.13	1.13½	Oct., 1920	0.03
Mining Corp. Can	Toronto	2.78	2.70	2.70	Jy.1, Jy.15 S\	0.12½
Nipissing	N. Y. Curb	5⅛	5⅛	5⅛	Se.30, Oc.20 Q	0.15
Temiskaming	Toronto	*9½	*9	*9½	Jan., 1920	0.40
SILVER-LEAD						
Ahumada	New York	5⅛	5⅛	5⅛	Se.28,Oc.1, QX	0.25
Alta Merger	Salt Lake	†*4	†*2			
Bingham Mines	Boston			34	Se.20,Se.30 Q	1.00
Cardiff M. & M	Salt Lake	*22	*22	*22	Nov., 1924	0.10
Chief Consol	Salt Lake	2.75	2.60	2.70	Oc.10, No.1 Q	0.10
Consti'n Mng.&Mill'g	Spokane	*57	*53	*56		
Emma Silver	Salt Lake	†1	†*75			
Erupcion	Boston Curb	1 1/16	1⅛	1 1/16	Se.25, Oc 1, QX	0.10
Federal M. & S	New York			90		
Federal M. & S., pfd.	New York	75	75	75	No 24, De.15 Q	1.75
Hawthorne Mines	N. Y. Curb	*12	*9	*11		
Hecla Mining	N. Y. Curb	16½	16⅛	16½	No.15,De.15 Q	0.50
Highland-Surprise	Spokane	*24	*23	*23½		
Iron King Mining	Salt Lake	*20	*18	*19		
Keystone Mining	Salt Lake	*25	*25	*25	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*15⅜	*15	*15¼		
Lucky Tiger-Com	Kansas City	†7.40	†7.00		Nov. 20, 1926	0.07
Mammoth Mining	Salt Lake	2.75	2.75	2.75	Mar.24,Apr. 1	0.10
Marsh Mines	Spokane	2⅞	2½	2½	Se.15, Oc 19	0.15
Park Utah	New York	6.40	6.25	6.25	Se.15, Oc 1 Q	0.15
Plutus Mining	Salt Lake	1.90	1.85	1.85	Oct. 15, Q	0.15
Prince Cons	Salt Lake			2¼		
Silver King Coal	Salt Lake	8.10	8.00	8.00	Se. 20, Oc.1, Q	0.25
Silversmith	Spokane	*37½	*33	*33	Oc.1, Oc.10 Q	0.02
Strattons Mines	Spokane	*50	*45	*45		
Sunshine M. Co	Spokane	*40½	*35½	*38		
Tamarack-Custer	Spokane	*52⅞	*50	*51½	Sept., 1924	0.25
Tintic Standard	Salt Lake	11.50	11.37½	11.37½	Se.13, Se.25 QX	0.40
Utah-Apex	Boston	6⅛	5⅞	5⅞	Oc.3, Oc.15 Q	0.25
Western Utah Copper	N. Y. Curb			*5		
IRON						
Bethlehem Steel	New York	45⅝	44	44½	July, 1924	1.25
Cleveland-Cliffs Iron	Cleveland	80	70	78	Oct., 1926	1.00
Colorado Fuel & Iron	New York	43⅝	40⅝	40⅝	May, 1921	0.75
Gt. North'n Iron Ore	New York	20⅛	19⅛	19⅜	Dec.6, Dec.28	0.75
Inland Steel	New York	40	40	40	No 15, De.1 Q	0.62½
Mesabi Iron	N. Y. Curb	1⅜	1⅛	1⅛		
Replogle Steel	New York	10¼	9⅞	9⅞		
Republic I. & S.	New York	57½	54	54	No.15, De.1 Q	1.00
Republic I. & S. pfd.	New York	99	97	97	De.15, Ja.2 Q	1.75
Sloss-Sheffield S. & I.	New York			97½	De.10, De 20 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	129	121½	121½	De 20, Ja 3 Q	1.75
U. S. Steel	New York	153⅜	143⅝	144⅜	De 1, De.30 Q	1.75
U. S. Steel pfd	New York	130	127¾	129⅞	No 2, No 29,Q	1.75
Virginia I. C. & C.	New York	52	50	50	Jan., 1924	1.50
Virginia I.C.&C.pfd	New York			78	De.15 Ja.2,	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM						
De Beers Consol	New York			35¼	Ju.16, Ju.17	1.70
So. Am. Gold & P	N. Y. Curb	4⅜	4	4		
Alum.Co.of Amer	N.Y.Curb	71⅛	70	71⅛		
Alum. Co. of Amer pf.	N.Y.Curb	103	102½	103	Oct.1, Q,	1.50
Vanadium Corp	New York	42⅛	41⅛	41¼	De.1, De.15, X	1.00
ASBESTOS						
Asbestos Corp., New	Montreal	23¼	22	22½	Jan., 1926	1.50
Asbestos Corp., pfd.	Montreal	82	81	81	Jy.1, Jy.15, SA	1.75
SULPHUR						
Freeport Texas	New York	31	30	30⅜	Nov., 1919	1.00
Texas Gulf, new	New York	49½	47½	49	De.1, De.15, Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	48⅜	47½	47⅞	No.19, De. 1, Q	1.00
Amer. Metal pfd	New York	113⅞	113⅞	113⅞	No.20, De.1 Q	1.75
Amer. Sm. & Ref.	New York	138⅞	132½	133⅜	Oc.15, No.1, Q	2.00
Amer. Sm.&Ref.pfd.	New York	119½	118¼	119½	No.5, De.1, Q	1.75
Consol. M. & S	N. Y. Curb			300	Jn.30, Jy.5	SAX 3.75
Federated Metals	N. Y. Curb			12		
Newmont Mining	N. Y. Curb	75¼	74½	75	Oc.1, Oc.15, Q	0.60
Southwest Metals	N. Y. Curb			1		
U. S. Sm. R. & M.	New York	37	35½	35½	Oc.7, Oc.15, Q	0.87½
U. S. Sm. R.&M.pfd.	New York	46½	45½	46½	Oc.7, Oc.15, Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Henry Sachs, Colorado Springs, Colo.

PRICE WEEK ENDED NOV. 9, 1926

Name	High	Low	Last	Last Divd. Date	Amount
Aramayo Mines (25 frs.)	78/9	75/—	77/6	Nov. 1926	5 p.c.†
British Platinum (£1)	4/3	2/6	3/—	Feb. 1925	2½ p.c.
Burma Corpn. (10 rupees)	14/9	14/3	14/6	Aug. 1926	7 annas*
Bwana M'Kubwa (5s)	7/4½	7/1½	7/3		
Camp Bird (2s)	3/7½	2/9	2/9		
El Ore (£1)	5/10½	5/7½	5/10½	Nov. 1924	2½ p.c.*
Esperansa (10s)	—/9	—/6	—/6		
Frontino & Bolivia (£1)	8/9	7/9	8/6	July 1926	2½ p.c.
Mexican Corpn. (£1)	10/9	9/3	10/6		
Mexico Mines of El Oro (£1)	22/6	20/—	22/6	June 1926	7½ p.c.
Oroville Dredging (£1)	3/—	2/7½	3/—	Dec. 1923	3¾ p.c.
Ouro Preto (£1)	2/3	1/10½	2/—	May 1925	2½ p.c.
Rhodesian Congo Border (£1)	108/1¼	90/—	92/6		
St. John del Rey (£1)	9/7½	9/1½	9/1½	June 1925	6¼ p.c.
San Francisco Mines (10s)	33/—	31/9	32/—	June 1926	15 p.c.
Santa Gertrudis (£1)	13/9	13/1½	13/9	Oct. 1926	3¾ p.c.
Selukwe (2s. 6d.)	12/9	11/9	12/—	April 1917	6¾ p.c.
S. Amer. Copper (2s.)	4/—	3/9	4/—	Nov. 1917	75 p.c.
Tanganvika (£1)	45/—	41/9	43/1½	Aug. 1926	7½ p.c.
Tomboy (£1)	3/7½	3/6	3/6	July 1926	10 p.c.
Union Miniere du Haut-Katanga (Brussels)	9.000	8.750	8.750	July 1926	175 (‡)

* Free of British income tax. † Swiss frs. ‡ Belgian frs. and free of taxation.